NAVSHIPS 0969-018-8000

CUH-803B/AF

3-A-44

**OPERATION, SERVICE INSTRUCTIONS, AND PARTS LIST**

for

C105

# MODEL 803B/AF

# DC DIFFERENTIAL VOLTMETER

John Fluke Manufacturing Co., Inc.
P. O. Box 7428, Seattle, Washington 98133

30 MARCH 1965

MODEL 803B/AF

# ADDENDA
# 803B/AF

This manual was intended for use with the 803B series AC/DC Differential Voltmeters. The 803B/AF, however, is a special version of the 803B/AG. Physical and electrical differences include:

1. The punched sheet metal instrument case is replaced with a MIL-T-945A military combination case constructed of aluminum, with a gasketed cover attached by separable hinges and spring-loaded pull-down latches. A storage compartment is built into the cover for accessories such as the input power cable and instruction manual. The combination case is equipped with a manual pressure relief valve to relieve pressure loading on the cover as required.

2. The instrument front panel is 3/16 inch aluminum for extra rigidity, and is secured to the combination case with ten No. 8 screws and captive nuts. A heavy one-piece rubber gasket is used between panel and case. The rear of the instrument chassis is supported within the case by high-density polyethylene foam (Ethafoam) corner blocks.

3. The instrument front panel is splashproofed as follows:

a. All voltage readout apertures are covered with moisture-proof, flush-mounted, clear plastic covers.
b. The Kelvin-Varley decade divider shafts are sealed against the panel by O-ring gaskets behind the shaft knobs.
c. The on-off toggle switch is enclosed in a full rubber boot.
d. All other switch and variable control bushings and shafts are sealed by special bushing nuts with neoprene collars.
e. Fuseholder and panel meter are gasketed against the panel.

4. Line power input is by way of an MS3102A-10SL-3P connector on the front panel. A 6-foot, 3-wire power input cable with an MS3106A-10SL-3S (C) mating connector, an AN3057-4 cable clamp, and a three-prong polarized line plug is furnished.

5. Recorder output binding posts located on the rear of the standard instrument are deleted.

6. The line fuse is relocated from the rear of the standard instrument to the front panel.

7. Heater resistors R6 and R7 are not used because the instrument is completely enclosed by the transit case.

8. The converter output diodes are selected for low leakage to provide for proper operation at the high operating temperatures reached within the transit case.

To facilitate the use of this manual, the following minor differences are listed according to section:

SECTION I - INTRODUCTION AND SPECIFICATIONS

Replace the 803B specifications with the complete specification for the 803B/AF as follows:

DIFFERENTIAL VOLTMETER SPECIFICATIONS

DC ACCURACY:
±0.05% of input from 0.1 VDC to 500 VDC
±(0.05% + 50 microvolts) below 0.1 VDC

AC ACCURACY:
20 cps to 10 kcps
±0.2% from 0.5 to 500 VAC
±(0.2% + 25 microvolts) from 0.001 to 0.5 VAC

LOW FREQUENCY AC ACCURACY:
10 cps to 20 cps
±(0.5% + 25 microvolts) from 0.001 to 500 VAC

5 cps to 10 cps
±(3% + 25 microvolts) from 0.001 to 500 VAC

INPUT VOLTAGE RANGE:
0 to 500, 50, 5, and 0.5V positive DC, negative DC, or AC

NULL VOLTAGE RANGES:
10, 1, 0.1, 0.01V full scale right or left deflection for DC
100, 10, 1, 0.1, 0.01, 0.001V full scale deflection for AC

DC INPUT IMPEDANCE:
Infinite at null from 0 to 500 VDC, in both positive and negative polarity

DC INPUT IMPEDANCE AT 1% OFF NULL (AS INDICATED BY METER):

| | |
|---|---|
| 10V null range: | 100 megohms per volt of input voltage |
| 1V null range: | 1,000 megohms per volt of input voltage |
| 0.1V null range: | 10,000 megohms per volt of input voltage |
| 0.01V null range: | 10,000 megohms per volt of input voltage |

AC INPUT IMPEDANCE:
1 megohm, 35 uuf (500 and 50 VAC ranges)
1 megohm, 50 uuf (5 and 0.5 VAC ranges)

VOLTAGE DIAL RESOLUTION:
10 microvolts maximum

METER RESOLUTION:
50 microvolts maximum (DC)
5 microvolts maximum (AC)

VACUUM TUBE VOLTMETER SPECIFICATIONS

INPUT VOLTAGE RANGES:
±500, ±50, ±5, ±0.5, ±10, ±1, ±0.1, ±0.01 VDC full scale right or left deflection

500, 50, 5, 0.5, 100, 10, 1, 0.1, 0.01, 0.001 VAC full scale deflection

ACCURACY:
±3% of full scale on all ranges

DC INPUT IMPEDANCE:
±500, ±50, ±5, ±0.5 VDC ranges - 50 megohms
±10, ±1, ±0.1 VDC ranges - 10 megohms
±0.01 VDC range - 1 megohm

AC INPUT IMPEDANCE:
1 megohm, 35 uuf (500 and 50 VAC ranges)
1 megohm, 50 uuf (5 and 0.5 VAC ranges)

GENERAL SPECIFICATIONS

REGULATION OF 500V REFERENCE SUPPLY:
±0.0025% for ±10% line voltage change

CALIBRATION:
500V reference supply calibrated to better than ±0.01% against temperature-compensated Zener diode

INPUT IMPEDANCE OF NULL DETECTOR:
10 megohms on 10, 1, 0.1V null ranges
1 megohm on 0.01V null range

SHOCK:
Meets requirements of MIL-T-945A & MIL-S-901B

VIBRATION:
Meets requirements of MIL-T-945A & MIL-STD-167

OPERATING TEMPERATURE RANGE:
0°C to 50°C (derated below 0°C to -30°C)

HUMIDITY:
100% operating
100% non-operating (case lid in place)

STORAGE TEMPERATURE RANGE:
-54°C to 65°C

COMBINATION CASE:
Watertight per MIL-STD-108D

FRONT PANEL:
Splashproof as defined in MIL-STD-108D

TERMINAL LINEARITY OF KELVIN-VARLEY DIVIDER:
±0.001% (10 ppm) from 0 to 0.1 of full scale
±0.001% to ±0.01% (10 ppm to 100 ppm) from 0.1 full scale to full scale

POLARITY SWITCH:
Reverses polarity of 500 VDC reference supply, so that identical impedance parameters are offered to both negative and positive DC voltages.

NULL DETECTOR:
Chopper-stabilized DC amplifier null detector is extremely stable; does not require front panel zero control.

WIRE INSULATION:
Teflon-insulated wire is used in critical circuits that may become subject to electrical leakage.

PANEL METER:
Taut-band suspension type

INPUT POWER:
115/230 VAC ±10%, 50 - 440 cps, approximately 75 watts

DIMENSIONS:
13-3/4" x 11-1/2" x 18-3/4" (lid closed)

## SECTION IV - MAINTENANCE

To be confident of the high accuracy inherent in the instrument over a wide temperature range, the instrument must be calibrated at normal operating temperature. Thus, the instrument should be allowed to warmup about 1-1/2 hours within the combination case. The calibration procedure may then be performed by sliding the instrument out of the case just long enough to make each individual adjustment. The instrument should be put back into the case after each adjustment and allowed to warmup to equilibrium temperature. If the instrument does not display the proper indication after reaching equilibrium temperature, the control must then be readjusted. However, the calibration procedure may be performed much faster by pulling the instrument out of the case far enough to reach all calibration controls and then taping a double thickness of polyethylene between the perimeter of the front panel and the perimeter of the case. With the polyethylene taped in this manner, the instrument may be slid from the case for each adjustment and still be maintained near equilibrium temperature. Holes may be punched into the polyethylene to reach the calibration controls.

## SECTION V - LIST OF REPLACEABLE PARTS

To create a parts list for the 803B/AF, change the 803B/AG list of replaceable parts as follows:

Delete:

| | | |
|---|---|---|
| | Front Panel Assembly | *138594 |
| CR501, CR502 | Diode, silicon, 60 ma, 40 PIV | 112359 |
| J4, J5 | Binding post, red | 104158 |
| | Binding post, insulator, dual black | *135053 |
| M1 | Meter, 100-0-100 microamp | 111211 |
| R1 | Resistor, variable wirewound 5 K ±10%, 2W | 111583 |
| R6, R7 | Resistor, wirewound, 6 K ±5%, 5W | *113449 |
| | Line cord, 3-wire | 102822 |
| | Rubber foot | 101253 |
| | Case Assembly (cabinet model) | *120386 |
| | Handle, flexible black vinyl, 5-1/2" (cabinet model) | 407-101 |
| CR301 | Zener Diode<br>NOTE: Moved to Zener Oven Assembly | 158824 |

Add:

| | | Mfr's Code | Mfr's Part No. |
|---|---|---|---|
| | Front Panel Assembly | 89536 | |
| | Case, instrument-transit | 84971 | KCP-01-05-16-M1 |
| | Connector (mates with line cord) | 02660 | MS3102A-10SL-3P |
| | Line cord<br>Cable & Line plug | 91934 | 019-3, SVT |
| | Connector | 02660 | MS3106A-10SL-3S(C) |
| | Cable clamp | 02660 | AN3057-4 |
| CR501, CR502 | Diode, silicon, 60 ma, 40 PIV (selected 113274) | | 803D/AC-402 |
| M1 | Meter, 100-0-100 microamp | 89536 | 111211-Weston |
| | Zener Oven Assembly<br>89536<br>Includes CR301<br>NOTE: The adhesive lable described on page 5-12 of the 803B Manual under CR301 has been relocated on the Zener Oven enclosure. | | 4807-222745 |

The following cross reference index provides the manufacturer's code and part number for the replaceable parts in the 803B/AF. The parts are listed by reference designation and Fluke stock number in the same order that they appear in Section V.

| Reference Designation | Fluke Stock No. | Mfr's Code | Mfr's Part No. |
|---|---|---|---|
| F1 | 109231 | 03614 | MDL-1.5 |
| Q3 | 116707 | 89536 | 116707 |
| T1 | 135012 | 89536 | 135012 |
| C1 | 105494 | 99515 | D6-474 |
| DS1, DS2, DS3, DS4 | 102855 | 89730 | 47 |
| | 100131 | 95236 | 7-14 |
| | 101428 | 89536 | 101428 |
| | 103440 | 89536 | 103440 |
| J2 | 101204 | 24655 | 938-C |
| J1, J3 | 104158 | 24655 | 938-D |
| | 135053 | 89536 | 135053 |
| | 101212 | 24655 | 938-F |
| | 101220 | 24655 | 938-L |
| R2 | 112714 | 71450 | Type 2-252 |
| S1 | 114850 | 04009 | 20994-LH |
| S2 | 120642 | 89536 | 120642 |
| S3 | 120659 | 89536 | 120659 |
| S4 | 134973 | 89536 | 134973 |
| S5 | 120691 | 89536 | 120691 |
| S6 | 134817 | 89536 | 134817 |
| S7, S8, S9 | 134841 | 89536 | 134841 |
| S10 | 134825 | 89536 | 134825 |
| | 101287 | 04645 | S-647-3L |
| | 101121 | 04645 | S-642-3-BB |

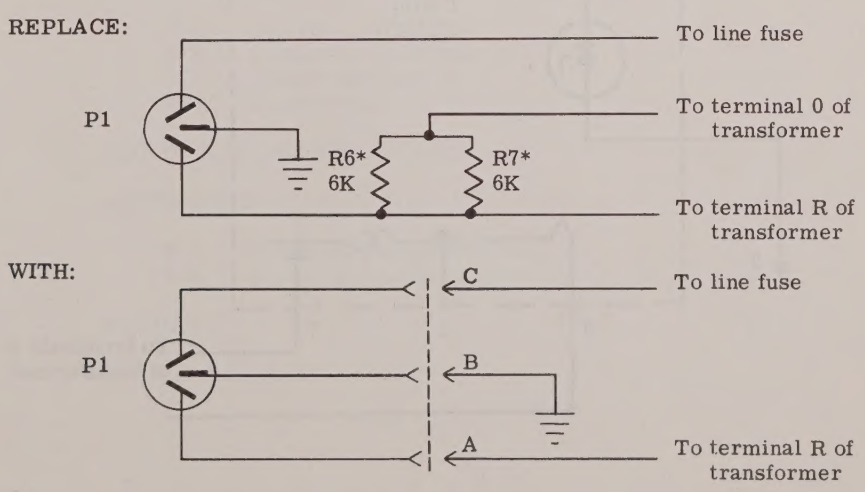
| Reference Designation | Fluke Stock No. | Mfr's Code | Mfr's Part No. |
|---|---|---|---|
| | 101311 | 04645 | S-653-3-BB-L |
| | 103614 | 04645 | S-653-3L-BB |
| | 107029 | 89536 | 107029 |
| | 125088 | 89536 | 125088 |
| C101, C102 | 105932 | 82376 | EYS-20-500 |
| C103 | 105163 | 56289 | D29220 |
| C104 | 105312 | 56289 | 67P10404 |
| C105 | 105916 | 84411 | 600UE03306 |
| C106 | 105833 | 84411 | 600UE10406 |
| C107 | 105668 | 56289 | 29C9B5 |
| CR101 thru | | | |
| CR103 | 112383 | 14099 | SC6 |
| CR104, CR105 | 112409 | 03877 | TM1 |
| Q1 | 117267 | 03508 | 2N2714 |
| Q2 | 116129 | 01295 | 2N1372 |
| R101 | 108134 | 04061 | EB1051 |
| R102 | 108217 | 04061 | EB2241 |
| R104 | 107235 | 00327 | Type C12 |
| R105 | 107433 | 00327 | Type C12 |
| R106 | 109017 | 04061 | EB8221 |
| R107, R108 | 107037 | 00327 | Type C12 |
| R109, R110 | 109512 | 04061 | GB2741 |
| R111 | 108233 | 04061 | EB2261 |
| R112 | 108647 | 04061 | EB1561 |
| R113 | 108142 | 04061 | EB1061 |
| R114 | 109397 | 04061 | GB1041 |
| R115 | 112417 | 00213 | Type 1700S |
| R116 | 108126 | 04061 | EB1041 |
| R117 | 109678 | 04061 | GB5641 |
| R118 | 108217 | 04061 | EB2241 |
| R119 | 108589 | 04061 | EB3311 |
| R120 | 109652 | 04061 | GB2241 |
| R121 | 111609 | 71450 | Type 110 |
| R122 | 109678 | 04061 | GB5641 |
| R123 | 112482 | 15909 | Type 1252 |
| R124 | 111948 | 15909 | Type 1112 |
| R125 | 108498 | 04061 | EB8231 |
| V101 | 116616 | 73445 | EL84/6BQ5 |
| V102 | 116749 | 89536 | 116749 |
| V103 | 100347 | 89730 | NE2E |
| V104, V105 | 115956 | 73445 | 12AX7 |
| | 150029 | 89536 | 150029 |
| C201, C202 | 106435 | 84411 | 663UW10402 |
| C203 | 106401 | 84411 | 600UE47301 |
| C204 | 106419 | 84411 | 600UE47402 |
| C205 | 105205 | 56289 | TE1095 |
| C206 | 105635 | 56289 | 30GA-D10 |
| C207 | 106351 | 56289 | TE1507 |
| C208 | 106435 | 84411 | 663UW10402 |
| C209 | 106419 | 84411 | 600UE47402 |
| C210 | 106435 | 84411 | 663UW10402 |
| C211 | 106450 | 84411 | X663UW10502 |
| C212 | 105189 | 56289 | 30D137A1 |
| C213 | 106849 | 56289 | 5GA-V75 |
| C214A, | | | |
| C214B | 106427 | 82376 | EY2X20-450 |
| C215 | 105700 | 56289 | TE1089 |
| CR201 | 112383 | 14099 | SC6 |
| CR202, | | | |
| CR203 | 116111 | 14099 | SC1 |
| G1 | 103051 | 98743 | C-2701 |

| Reference Designation | Fluke Stock No. | Mfr's Code | Mfr's Part No. |
|---|---|---|---|
| R201 thru | | | |
| R203 | 108134 | 04061 | EB1051 |
| R204 | 108548 | 04061 | EB3951 |
| R205 | 108266 | 04061 | EB2751 |
| R206 | 108290 | 04061 | EB4741 |
| R207 | 108381 | 04061 | EB4721 |
| R208 | 108118 | 04061 | EB1031 |
| R209, R210 | 108134 | 04061 | EB1051 |
| R211 | 108274 | 04061 | EB3341 |
| R212 | 108431 | 04061 | EB1841 |
| R213 | 108563 | 04061 | EB1021 |
| R214 | 108134 | 04061 | EB1051 |
| R215 | 108878 | 04061 | EB2731 |
| R216 | 108563 | 04061 | EB1021 |
| R217 | 108100 | 04061 | EB1011 |
| R218 | 151084 | 75042 | Type CEC-TO |
| R219 | 112672 | 71450 | Type 110 |
| R220 | 108373 | 04061 | EB3321 |
| R221 | 108605 | 04061 | EB2221 |
| R222, R223 | 110015 | 04061 | HB4731 |
| R224 | 108845 | 04061 | EB27G1 |
| R225, R226 | 108563 | 04061 | EB1021 |
| R227 | 111609 | 71450 | Type 110 |
| R228, R229 | 110148 | 04061 | HB2721 |
| R230 | 108563 | 54061 | EB1021 |
| V201 | 100347 | 89730 | NE2E |
| V202 | 116715 | 73445 | EF86/6267 |
| V203 | 116434 | 49671 | 6AW8A |
| V204 | 115873 | 49671 | OA2 |
| | 153478 | 89536 | 153478 |
| C301 | 105924 | 99515 | E6-105 |
| C302 | 106443 | 84411 | X663UW20502 |
| CR301 | 158824 | 89536 | 158824 |
| R301 thru | | | |
| R304 | 107748 | 00327 | Type C13 |
| R305 | 107557 | 00327 | Type C13 |
| R306 | 107391 | 00327 | Type C12 |
| R307 | 107292 | 00327 | Type C12 |
| R308 | 107250 | 00327 | Type C12 |
| R309 | 107771 | 00327 | Type C12 |
| R310 | 107730 | 00327 | Type C12 |
| R311 thru | | | |
| R315 | 108233 | 04061 | EB2261 |
| R316, R317 | 112110 | 15909 | Type 1181F |
| R318 | 113266 | 71450 | Type 110 |
| R320, R321 | 112110 | 15909 | Type 1181F |
| R322 | 109504 | 04061 | GB2731 |
| R323 | 113258 | 71450 | Type 110 |
| R324 | 112060 | 15909 | Type 1141 |
| R325 | 112045 | 15909 | Type 1141 |
| R326 | 113258 | 71450 | Type 110 |
| R327 | 111906 | 15909 | Type 1141 |
| R328 | 112052 | 15909 | Type 1141 |
| R329 | 113258 | 71450 | Type 110 |
| R330 | 112011 | 15909 | Type 1141 |
| R331 | 108241 | 04061 | EB2711 |
| | 134775 | 89536 | 134775 |
| R401 - R406 | 146530 | 89536 | 146530 |
| R407 - R417 | 131946 | 89536 | 131946 |
| R418 - R428 | 131953 | 89536 | 131953 |
| R429 - R439 | 146159 | 89536 | 146159 |

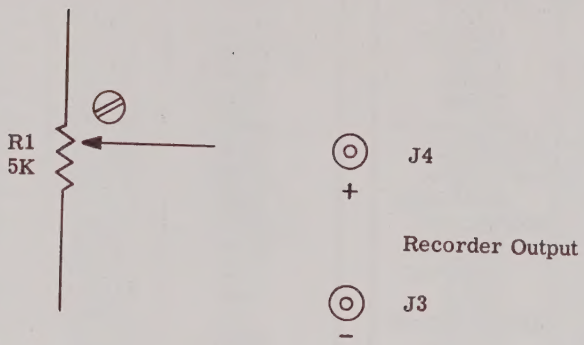
| Reference Designation | Fluke Stock No. | Mfr's Code | Mfr's Part No. | Reference Designation | Fluke Stock No. | Mfr's Code | Mfr's Part No. |
|---|---|---|---|---|---|---|---|
| R440-R449 | 146167 | 89536 | 146167 | R526 | 108217 | 04061 | EB2241 |
| | 120527 | 89536 | 120527 | R527 | 108688 | 04061 | EB4701 |
| | 120535 | 89536 | 120535 | R528 | 111138 | 07115 | Type C42S |
| C505AB | 105130 | 56289 | D29221 | R529 | 109397 | 04061 | GB1041 |
| C506 | 105650 | 04061 | DD502 | R530 | 111187 | 07115 | Type LP1-15 |
| C507 | 105734 | 71590 | BB60301KW7W | R531 | 108191 | 04061 | EB2211 |
| C508 | 106419 | 84411 | 600UE47402 | R532 | 108290 | 04061 | EB4741 |
| C509 | 106591 | 84411 | 600UE10204 | R536 | 112433 | 71450 | Type 110 |
| C510 | 105635 | 56289 | 30GA-D10 | R537 | 107185 | 00327 | Type C12 |
| C511 | 106419 | 84411 | 600UE47402 | R538 | 113217 | 01686 | Type C41-PCB |
| C512 | 105312 | 56289 | 67P10404 | R539 | 112805 | 89536 | 112805 |
| C513 | 106229 | 56289 | 30D198A1 | V501 | 116699 | 73445 | 6EJ7/EF86 |
| C514 | 106393 | 71590 | UK225 | V502 | 116434 | 49671 | 6AW8A |
| C515 | 106443 | 84411 | X663UW-20502 | | 120543 | 89536 | 120543 |
| C516 | 105924 | 99515 | E6-105 | R503 | 113209 | 71450 | Type 110 |
| C517 | 106997 | 99515 | D2-505D | R534 | 112870 | 71450 | Type 110 |
| C518 | 106443 | 84411 | X663UW-20502 | C501 | 105023 | 73899 | VCJ1014 |
| C522 | 106328 | 56289 | 30D120A1 | C502 | 105619 | 71590 | TU20200KCOG |
| CR503 | 116111 | 14099 | SC1 | C503 | 107003 | 84411 | 663UW12456W |
| R506, R507 | 111112 | 07115 | Type C42S | C523 | 105023 | 73899 | VCJ1014 |
| R508 | 111104 | 07115 | Type C42S | C524 | 105601 | 71590 | TU45301KCOG |
| R509 | 111195 | 07115 | Type LP1-5 | C525 | 105940 | 71590 | TCZ-82 |
| R510, R511 | 108373 | 04061 | EB3321 | R501 | 111146 | 15909 | Type DA2 |
| R512 | 108191 | 04061 | EB2221 | R502 | 111260 | 15909 | Type DA2 |
| R513 | 108241 | 04061 | EB2711 | R533 | 111153 | 15909 | Type DA2 |
| R514 | 108720 | 04061 | EB1851 | R535 | 112813 | 15909 | Type 1137 |
| R515 | 108225 | 04061 | EB2251 | R543 | 111153 | 15909 | Type DA2 |
| R516 | 108647 | 04061 | EB1561 | R544 | 108993 | 04061 | EB3941 |
| R517 | 108985 | 04061 | EB1861 | C504, C519 | 105023 | 73899 | VCJ1014 |
| R518 | 108720 | 04061 | EB1851 | C520 | 106583 | 71590 | TCZ-3R3 |
| R519 | 108688 | 04061 | EB4701 | C521 | 105940 | 71590 | TCZ-82 |
| R520 | 111120 | 07115 | Type C42S | R504 | 111252 | 15909 | Type DA2 |
| R521 | 108571 | 04061 | EB1811 | R505 | 108688 | 04061 | EB4701 |
| R522 | 108118 | 04061 | EB1031 | R540 | 111245 | 15909 | Type DA2 |
| R523 | 108365 | 04061 | EB3911 | R541 | 113191 | 80294 | 275-1-202 |
| R524 | 108274 | 04061 | EB3341 | R542 | 111443 | 15909 | Type DA2 |
| R525 | 108290 | 04061 | EB4741 | S2 | 120683 | 89536 | 120683 |

SCHEMATIC DIAGRAM

To create a schematic diagram for the 803B/AF, change the 803B/AG schematic as follows:



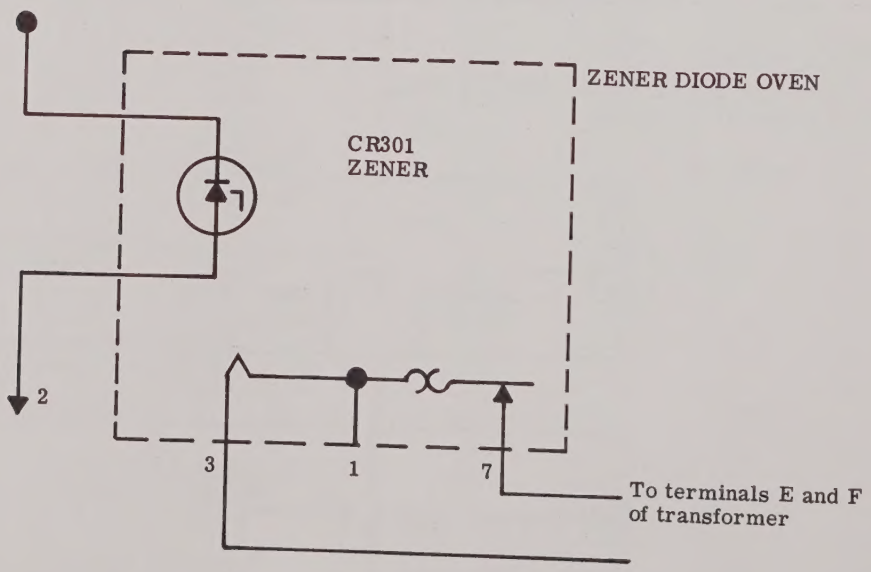
DELETE:




NOTE: A number of parts associated with recorder output are left in the instrument and are not used.

REPLACE:

WITH:



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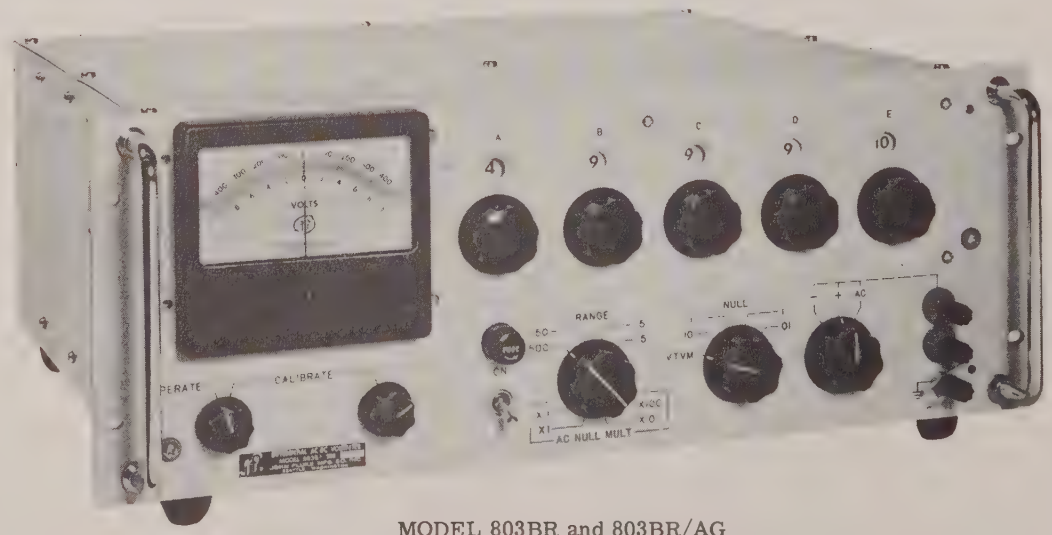
MODEL 803B and 803B/AG




MODEL 803BR and 803BR/AG

# SECTION I

# INTRODUCTION AND SPECIFICATIONS

## 1-1. INTRODUCTION

a. This instruction manual is for use with the 803B series AC/DC Differential Voltmeters. These are available in either a cabinet model or a standard 19 inch rack model, and with either a standard cell or a Zener diode as the reference element. Model designations are: 803B (cabinet model, standard cell); 803BR (rack model, standard cell); 803B/AG (cabinet model, Zener diode); and 803BR/AG (rack model, Zener diode).

b. The high accuracy, portability, and compactness of the 803B make this instrument ideal for the precise measurement of almost any AC or DC voltage. Ease of operation, inherent protection from accidental overload, and high reliability contribute to the outstanding performance that assures suitability for both production line testing and precision laboratory measurements. This instrument is capable of being used as a vacuum voltmeter, as a precision potentiometer, and as a megohmmeter for measurement of high resistance. It can also be used to measure the excursions of a voltage about some nominal value. One feature that should be emphasized is that no current is drawn from the unknown source for DC measurements when balance is attained. Thus the determination of the unknown DC potential is independent of its source resistance. The 803B is basically used for measurements of DC voltages from 0 to 500 volts and AC voltages from 0.001 to 500 volts. However, high accuracy measurements to 30,000 volts DC are possible with precision voltage dividers especially designed for use with the Fluke Model 800 Series Differential Voltmeters. As additional features, this instrument contains a polarity switch for equal convenience in measuring positive or negative DC voltages and an adjustable recorder output which makes the 803B particularly useful for monitoring the stability of almost any AC or DC voltage. Furthermore, the 803B meter has taut-band suspension which eliminates problems due to meter stickiness.

c. When used as a DC Differential Voltmeter, the 803B operates on the potentiometric principal. An unknown voltage is measured by comparing it to a known adjustable reference voltage with the aid of a null detector. An accurate standard for measurements is obtained by setting the reference supply with a standard cell for the 803B and 803BR and with a Zener power supply for the 803B/AG and 803BR/AG. The known adjustable reference voltage is provided by a 500 volt DC power supply and five Kelvin-Varley decade resistor strings that are set accurately by five voltage readout dials. In this way, the 500 volts can be precisely divided into increments as small as 10 microvolts. The unknown voltage is then simply read from the voltage dials.

When used as an AC Differential Voltmeter, the 803B operates essentially the same as for DC differential measurements. The AC input voltage is converted to a DC voltage and this DC voltage is measured by comparing it to a known adjustable reference voltage. In the highest null sensitivity range, potential differences between the unknown and the reference voltage of only 0.01 volts for DC and 0.001 volts for AC will cause full scale meter deflection.

d. The instrument is normally supplied ready for use on 115 volts. Upon request, instruments are supplied for 230 volts operation. If it becomes desirable to convert from one mode of operation to the other, refer to the instruction decal on the back of cabinet models or on the cover in rack models.

## 1-2. DAMAGE IN SHIPMENT

Immediately upon receipt, thoroughly inspect for any damage that may have occurred in transit. If any damage is noted, follow the instructions outlined on the warranty page at the back of this manual.

## 1-3. SPECIFICATIONS

AS A PRECISION POTENTIOMETER

DC ACCURACY:

±0.05% of input voltage from 0.1 to 500 VDC
±(0.05% +50 uv) below 0.1 VDC

AC ACCURACY:

| Input Voltage | | 0.5 to 500 | 0.001 to 0.5 |
|---|---|---|---|
| Basic AC Accuracy from 20 cps to 10 kc | | ±0.2% | ±(0.2% + 25 uv) |
| Low Frequency AC Accuracy | from 10 cps to 20 cps | ±0.5% | ±(0.5% + 25 uv) |
| | from 5 cps to 10 cps | ±3% | ±(3% + 25 uv) |

RANGE:

For DC Measurements

| Input Voltage Range | Recommended Null Range* | Input Resistance Per volt of input voltage | |
|---|---|---|---|
| | | At Null | 1% of Full Scale Off Null |
| 50-500 | 10-0-10 | Infinite | 100 Meg |
| | 1-0-1 | Infinite | 1,000 Meg |
| 5-50 | 1-0-1 | Infinite | 1,000 Meg |
| | 0.1-0-0.1 | Infinite | 10,000 Meg |
| 0.5-5 | 0.1-0-0.1 | Infinite | 10,000 Meg |
| | 0.01-0-0.01 | Infinite | 10,000 Meg |
| 0-0.5 | 0.1-0-0.1 | Infinite | 10,000 Meg |
| | 0.01-0-0.01 | Infinite | 10,000 Meg |

*Any null range may be used with any input voltage range; recommended ranges are those most useful.

For AC Measurements

| Input Voltage Range | Recommended Null Range | Input Impedance |
|---|---|---|
| 50-500 | 100-0-100 | 1 Meg, 35 uuf |
| | 10-0-10 | 1 Meg, 35 uuf |
| | 1-0-1 | 1 Meg, 35 uuf |
| 5-50 | 10-0-10 | 1 Meg, 35 uuf |
| | 1-0-1 | 1 Meg, 35 uuf |
| | 0.1-0-0.1 | 1 Meg, 35 uuf |
| 0.5-5 | 1-0-1 | 1 Meg, 50 uuf |
| | 0.1-0-0.1 | 1 Meg, 50 uuf |
| | 0.01-0-0.01 | 1 Meg, 50 uuf |
| 0.001-0.5 | 0.1-0-0.1 | 1 Meg, 50 uuf |
| | 0.01-0-0.01 | 1 Meg, 50 uuf |
| | 0.001-0-0.001 | 1 Meg, 50 uuf |

RESOLUTION:

Voltage Readout Dial Resolution

| Range Setting | Null Setting | Resolution |
|---|---|---|
| 500 | any | 10 mv |
| 50 | any | 1 mv |
| 5 | any | 0.1 mv |
| 0.5 | any | 0.01 mv |

Meter Resolution
(1/4 of a small scale meter division)

| Polarity Setting | Range Setting | Null Setting | Resolution |
|---|---|---|---|
| DC | any | 10 | 50 mv |
| DC | any | 1 | 5 mv |
| DC | any | 0.1 | 0.5 mv |
| DC | any | 0.01 | 0.05 mv |
| AC | 500 | 1 | 500 mv |
| AC | 500 | 0.1 | 50 mv |
| AC | 50 | 1 | 50 mv |
| AC | 500 | 0.01 | 5 mv |
| AC | 50 | 0.1 | 5 mv |
| AC | 5 | 1 | 5 mv |
| AC | 50 | 0.01 | 0.5 mv |
| AC | 5 | 0.1 | 0.5 mv |
| AC | 0.5 | 1 | 0.5 mv |
| AC | 5 | 0.01 | 0.05 mv |
| AC | 0.5 | 0.1 | 0.05 mv |
| AC | 0.5 | 0.01 | 0.005 mv |

AS A VACUUM TUBE VOLTMETER

ACCURACY: 3% on all ranges

RANGE:

| | Voltage Ranges | Input Impedance |
|---|---|---|
| DC: | 500-0-500 | 50 Meg |
| | 50-0-50 | 50 Meg |
| | 5-0-5 | 50 Meg |
| | 0.5-0-0.5 | 50 Meg |
| | 10-0-10* | 10 Meg |
| | 1-0-1* | 10 Meg |
| | 0.1-0-0.1* | 10 Meg |
| | 0.01-0-0.01* | 1 Meg |
| AC: | 0-500 | 1 Meg, 35 uuf |
| | 0-50 | 1 Meg, 35 uuf |
| | 0-5 | 1 Meg, 50 uuf |
| | 0-0.5 | 1 Meg, 50 uuf |
| | 0-100** | 1 Meg, 35 uuf |
| | 0-10** | 1 Meg, 35 uuf |
| | 0-1** | 1 Meg, 35 uuf |
| | 0-0.1** | 1 Meg, 35 uuf |
| | 0-0.01** | 1 Meg, 50 uuf |
| | 0-0.001** | 1 Meg, 50 uuf |

*These ranges are obtained by using Null ranges with all five voltage readout dials set to 0.

**These ranges are obtained by the proper setting of the range and null switches with all five voltage readout dials set to 0.

## GENERAL SPECIFICATIONS

REGULATION AND STABILITY OF 500 VOLT SUPPLY:

±0.0025% for a ±10% line change
±0.005% per hour after 30 min. warmup

STABILITY OF METER ZERO:

±0.5% of full scale for a 10% change in line voltage from a line frequency of 50 to 120 cps and ±1% of full scale for a 10% change in line voltage from a line frequency of 120 to 440 cps.

OPERATING TEMPERATURE RANGE:

Within DC specifications from 40°F to 105°F: Derate accuracy at 0.001% per °F outside these limits to 35°F and 110°F for standard cell models (803B and 803BR) or to 0°F and 125°F for Zener diode reference models (803B/AG and 803BR/AG). Below 0°F the Zener diode reference models operate with an accuracy of ±0.09% derated at 0.002%/°F to -25°F.

Within AC specifications from 55°F to 95°F: Derate accuracy at 0.005% per °F outside these limits to 35°F and 110°F for standard cell models (803B and 803BR) or to 0°F and 125°F for Zener diode reference models (803B/AG and 803BR/AG). Below 0°F the Zener diode reference models operate with an accuracy of 0.3% derated at 0.005%/°F to -25°F.

RELATIVE HUMIDITY:

Within specifications from 0 to 80% relative humidity.

SHOCK AND VIBRATION:

Meets requirements of MIL-T-945A

INPUT POWER:

115/230 volts AC (±10%), 50-440 cps, 75 watts. (Note: Models 803B and 803B/AG serial numbers 123 to 2616 and Models 803BR and 803BR/AG serial numbers 123 to 851 were manufactured to operate on line power frequencies from 50 to 70 cps.)

DIMENSIONS:

Cabinet Model-13" high, 9-3/4" wide, 16" deep.
Rack Model-7" high, 19" wide, 15-1/2" deep.

WEIGHT:

Cabinet Model-27-1/2 lbs.
Rack Model-25 lbs.

# SECTION II

# OPERATING INSTRUCTIONS

## 2-1. CONTROLS, TERMINALS, AND INDICATORS

The location, circuit symbol, and a functional description of external controls, terminals, and indicators on the 803B Precision AC/DC Differential Voltmeter may be found in figure 2-1.

| CONTROLS TERMINALS AND INDICATORS | LOCATION | CIRCUIT SYMBOL | FUNCTIONAL DESCRIPTION |
|---|---|---|---|
| Input terminals | Front panel | J1, J3 | Provided for connecting AC or DC voltage to be measured. |
| Chassis ground terminal | Front panel | J2 | Provided for grounding purposes. A 0.47 uf capacitor is connected from the lower input binding post to the chassis ground post. The upper input post should never be connected to the chassis ground post. Since the instrument is equipped with a three-wire line cord with the third wire fastened to the chassis, the external circuit should be checked for conflicts in grounding before connecting lower input binding post (middle post) to the chassis post. |
| Power toggle switch | Front panel | S1 | Applies AC line voltage to the primary circuit of the power transformer. |
| OPERATE-CALIBRATE switch | Front panel | S4 | Remains in the OPERATE position at all times except when it is necessary to calibrate the internal 500 volt DC reference supply. When held in the CALIBRATE position, a representative sample of the reference voltage is compared to the voltage of an internal standard cell, or Zener reference diode for the /AG models, and any difference is indicated on the meter. |
| CALIBRATE control | Front panel | R2 | Varies the output of the 500 volt DC reference supply. When the OPERATE-CALIBRATE switch is held in the CALIBRATE position, the reference supply is accurately set by adjusting the CALIBRATE control for zero meter deflection. |
| RANGE switch | Front panel | S2 | Selects desired voltage range. Full scale voltage ranges of 500, 50, 5, and 0.5 volts are available. It also indicates the AC NULL MULT for each range position. |

Figure 2-1. CONTROLS, TERMINALS, AND INDICATORS (sheet 1 of 2)

| CONTROLS TERMINALS AND INDICATORS | LOCATION | CIRCUIT SYMBOL | FUNCTIONAL DESCRIPTION |
|---|---|---|---|
| NULL switch | Front panel | S3 | Set to VTVM for determining the approximate value of unknown voltage prior to differential measurements. Four null switch ranges of 10, 1, 0.1, and 0.01 volts are used for differential measurements. For the DC mode, the null ranges represent full scale differences between the unknown voltage and the amount of precision internal reference voltage that is set on the voltage readout dials. For the AC mode, the null range used times the applicable AC Null Multiplier, indicated by the range switch, represents the full scale difference between the unknown voltage and the amount set on the voltage dials. |
| A, B, C, D, and E voltage readout dials | Front panel | S6, S7, S8, S9, S10 | Provide an in-line readout of the amount of internal reference voltage necessary to null the unknown voltage. |
| Decimal lights | Front panel | DS1, DS2, DS3, DS4 | Serve as decimal points for the voltage readout dials. A different light illuminates for each position of the RANGE switch. |
| AC - DC polarity switch | Front panel | S5 | Selects the AC, + DC, or - DC mode of operation. With this switch in the positive position, the polarity of the upper input binding post is positive with respect to the lower input binding post (middle post). |
| Output terminals | Rear panel | J4, J5 | Provided for attaching a recorder to monitor voltage excursions. |
| Output level control | Rear panel | R1 | Varies the output level of the output binding post from 0 to approximately 20 millivolts full scale deflection. |
| Meter | Front panel | M1 | Indicates approximate voltage when 803B is in VTVM mode and difference between unknown and internal reference voltage when 803B is in differential mode. The upper scale, 500-0-500, is used when the NULL switch is set to VTVM. At all other times, the lower scale, 1-0-1, is used. |
| Mechanical zero control | Meter case | None | Sets meter to zero mechanically. This adjustment should be used only after instrument has been turned off for at least three minutes or when the internal meter terminals have been shorted. |
| Fuse | Rear panel of cabinet models, front panel of rack models. | F1 | Fuse holder protrudes from instrument to provide easy access to the fuse. The fuse is a 1.5 ampere slow blowing type for 115 volt operation and a 0.75 ampere slow blowing type for 230 volt operation. |

Figure 2-1. CONTROLS, TERMINALS, AND INDICATORS (sheet 2 of 2)

## 2-2. ZEROING INSTRUCTIONS

From time to time, it may be necessary to adjust the internal meter zero control. This will normally be done at somewhat more frequent intervals than complete instrument calibration. It may also be necessary to adjust the internal meter zero control when the instrument is operated on a different line frequency than that at which it was originally zeroed. Proceed as follows:

a. Mechanically zero the meter with the adjustment screw on the front of the meter case. If the instrument is in the case, it must be shut off for at least three minutes prior to this adjustment. If out of case, another method would be to short out the internal meter terminals prior to zeroing.

b. Set power switch to ON and allow a 20 minute warmup period.

c. Set RANGE switch to 5 or 0.5 volts, voltage readout dials to zero, and NULL switch to 0.01 volts.

d. Adjust R227, null detector ZERO ADJ, for zero meter deflection. This control may be reached through the ventilation holes in the cabinet model (see figure 4-3). In the rack model, an identified access hole is provided on the rear panel.

## 2-3. PRELIMINARY OPERATION

The following procedure prepares the voltmeter for operation.

a. Connect power plug to a 115 volt AC power source. If instrument has been wired for 230 volt operation, connect to 230 volts AC.

NOTE

The round pin on polarized three-prong plug connects instrument case to power system ground. Use a three-to-two pin adapter when connecting to a two-contact receptacle. For personnel safety, connect short lead to a suitable ground.

b. Set controls on 803B voltmeter as follows:

| | |
|---|---|
| RANGE | 500 volts |
| NULL | VTVM |
| AC-DC polarity | + (positive) |
| all voltage readout dials | 0 (zero) |
| power | ON |

c. After a warmup period of at least ten minutes, advance OPERATE-CALIBRATE switch against spring tension to CALIBRATE, and adjust internal 500 volt DC reference supply with CALIBRATE control for zero meter deflection. Release OPERATE-CALIBRATE switch.

## 2-4. OPERATION AS A DC DIFFERENTIAL VOLTMETER

a. After completing preliminary operation, connect unknown voltage to input binding posts. If one side is grounded, always connect it to the lower input post (middle post).

b. Turn RANGE switch to lowest range that will allow an on-scale reading and note approximate value of unknown voltage as indicated on upper meter scale.

c. If meter reads to the left, turn AC - DC polarity switch to the negative position. The meter needle will deflect to the right. This is because polarity of unknown voltage is negative.

d. Noting the position of illuminated decimal light, set five voltage readout dials to approximate voltage determined in step b. For example, if approximate voltage is 35 volts, the decimal light between the B and C voltage readout dials will be illuminated. Therefore, set A dial to 3, B dial to 5, and C, D, and E dials to 0.

e. Set NULL switch to successively more sensitive null ranges, as indicated in figure 2-2, and adjust voltage readout dials for zero meter deflection in each null position. When the meter needle indicates to the right, the voltage under measurement is greater than the voltage set on the voltage readout dials. When the indication is to the left, the voltage is less than that set on the readout dials.

| INPUT VOLTAGE RANGE | *RECOMMENDED NULL SETTING |
|---|---|
| 50-500 | 10 then 1 (then 0.1 for voltages from 50 to 100 volts) |
| 5-50 | 1 then 0.1 (then 0.01 for voltages from 5 to 10 volts) |
| 0.5-5 | 0.1 then 0.01 |
| 0-0.5 | 0.1 then 0.01 |

*Any null range may be used with any input voltage range; recommended settings are those most useful.

Figure 2-2. RECOMMENDED NULL SETTINGS

f. Read unknown voltage directly from the five voltage readout dials.

## 2-5. OPERATION AS AN AC DIFFERENTIAL VOLTMETER

a. After completing preliminary operation, set AC-DC polarity switch to AC.

b. Connect unknown AC voltage to input binding posts.

c. Turn RANGE switch to lowest range that will allow an on-scale reading and note approximate value of unknown voltage as indicated on upper meter scale.

d. Noting the position of illuminated decimal light, set five voltage dials to approximate voltage determined in step c. For example, if approximate voltage is 35 volts, the decimal light between the B and C voltage dials

will be illuminated. Therefore, set A dial to 3, B dial to 5, and C, D, and E dials to 0.

e. Set null switch to 0.1 and then 0.01 volt, adjusting voltage dials for zero meter deflection in each position.

f. Read unknown voltage from the five voltage readout dials.

## 2-6. OPERATION AS A CONVENTIONAL VTVM

If it is desired to use the instrument as a VTVM only, additional ranges can be made available by converting the NULL ranges to VTVM ranges. This is made possible by setting the voltage readout dials to zero. Proceed as follows:

a. Perform preliminary operation procedures as stated in paragraph 2-3.

b. Consult figure 2-3, and select full scale voltage deflection desired. If the approximate value of the voltage to be measured is unknown, select the 500 volt range initially.

c. Set AC-DC polarity switch, RANGE switch, NULL switch, and voltage dials as indicated for the range selected.

d. Connect voltage to be measured to input binding posts. Deflection to the right indicates that an unknown DC voltage is of positive polarity. An unknown AC voltage will always cause deflection to the right.

e. Read voltage from upper or lower scale as listed in figure 2-3.

| Full-Scale Deflection | AC-DC Polarity Switch | Range Switch | Null Switch | Voltage Readout Dials | Meter Scale |
|---|---|---|---|---|---|
| DC: | | | | | |
| 500-0-500 | DC | 500 | VTVM | No effect | Upper |
| 50-0-50 | DC | 50 | VTVM | No effect | Upper |
| 5-0-5 | DC | 5 | VTVM | No effect | Upper |
| 0.5-0-0.5 | DC | 0.5 | VTVM | No effect | Upper |
| 10-0-10 | DC | No effect | 10 | All zero | Lower |
| 1-0-1 | DC | No effect | 1 | All zero | Lower |
| 0.1-0-0.1 | DC | No effect | 0.1 | All zero | Lower |
| 0.01-0-0.01 | DC | No effect | 0.01 | All zero | Lower |
| AC: | | | | | |
| 0-500 | AC | 500 | VTVM | No effect | Upper |
| 0-50 | AC | 50 | VTVM | No effect | Upper |
| 0-5 | AC | 5 | VTVM | No effect | Upper |
| 0-0.5 | AC | 0.5 | VTVM | No effect | Upper |
| 0-100 | AC | 500 | 1 | All zero | Lower |
| 0-10 | AC | 500 | 0.1 | All zero | Lower |
| | | 50 | 1 | | |
| 0-1 | AC | 500 | 0.01 | All zero | Lower |
| | | 50 | 0.1 | | |
| | | 5 | 1 | | |
| 0-0.1 | AC | 50 | 0.01 | All zero | Lower |
| | | 5 | 0.1 | | |
| | | 0.5 | 1 | | |
| 0-0.01 | AC | 5 | 0.01 | All zero | Lower |
| | | 0.5 | 0.1 | | |
| 0-0.001 | AC | 0.5 | 0.01 | All zero | Lower |

Figure 2-3. VTVM RANGES

## 2-7. MEASUREMENT OF VOLTAGE EXCURSIONS ABOUT A NOMINAL VALUE

a. After completing preliminary operation as stated in paragraph 2-3, set AC-DC polarity switch to desired position.

b. Connect voltage to be observed to input binding posts. If meter reads to the left, the voltage being measured is negative DC; set polarity switch to the negative position in this case. This will cause meter pointer to deflect to the right.

c. Set RANGE switch to lowest range which will give an on-scale meter indication and note nominal value of voltage indicated.

d. Set the five voltage readout dials to nominal voltage.

e. Turn NULL switch to lowest position that will allow voltage excursions to remain on scale.

f. Read voltage excursions from meter. Note that full scale right and left meter deflections are equal to the NULL voltage setting for DC measurements. For AC measurements, full scale right and left meter deflections are equal to the NULL voltage setting multiplied by the AC NULL MULT indicated by the RANGE setting. Figure 2-4 shows full scale AC deflections for the recommended settings of the range and null switches.

| Range Switch Setting | Null Switch Setting | AC Null Multiplier | Full Scale AC Deflection (in volts) |
|---|---|---|---|
| 500 | 1<br>0.1<br>0.01 | X100 | 100<br>10<br>1 |
| 50 | 1<br>0.1<br>0.01 | X10 | 10<br>1<br>0.1 |
| 5 | 1<br>0.1<br>0.01 | X1 | 1<br>0.1<br>0.01 |
| 0.5 | 1<br>0.1<br>0.01 | X0.1 | 0.1<br>0.01<br>0.001 |

Figure 2-4. FULL SCALE AC DEFLECTIONS

## 2-8. USE OF 803B WITH A RECORDER

Recorder output binding posts and an output level control are provided on the 803B for monitoring the excursions of an unknown voltage from the voltage indicated by the voltage dial settings. If the leakage resistance between the recorder and ground is less than 10,000 megohms, the accuracy of the 803B will be impaired. Also, both input posts of the recorder should be able to stand 500 volts DC to ground. Therefore, the John Fluke Model A-70 Potentiometric Recorder (manufactured by the Texas Instrument Co.) is recommended for this application. Set up the recorder as follows:

a. Connect A-70 recorder to 803B voltmeter with teflon leads as shown in figure 2-5.

CAUTION

Do not ground either of the 803B output terminals or either of the A-70 input terminals. If any of these terminals are grounded, current will be drawn from the 803B Kelvin-Varley voltage divider and the accuracy of the 803B will be completely destroyed.

b. After connecting the recorder, perform preliminary operation as stated in paragraph 2-3.

c. Check for excessive leakage as follows:

(1) Connect a dc voltage to the input of the 803B and differentially measure its potential in a recommended null range.

(2) Alternately connect and disconnect the recorder leads from the output terminals of the 803B while noting the meter needle deflection. More than one-scale division deflection indicates that excessive leakage has been introduced by the recorder. This will impair the accuracy of the 803B voltmeter.

(3) Disconnect the voltage.

d. After the leakage test has been successfully completed, short the input terminals of the 803B.

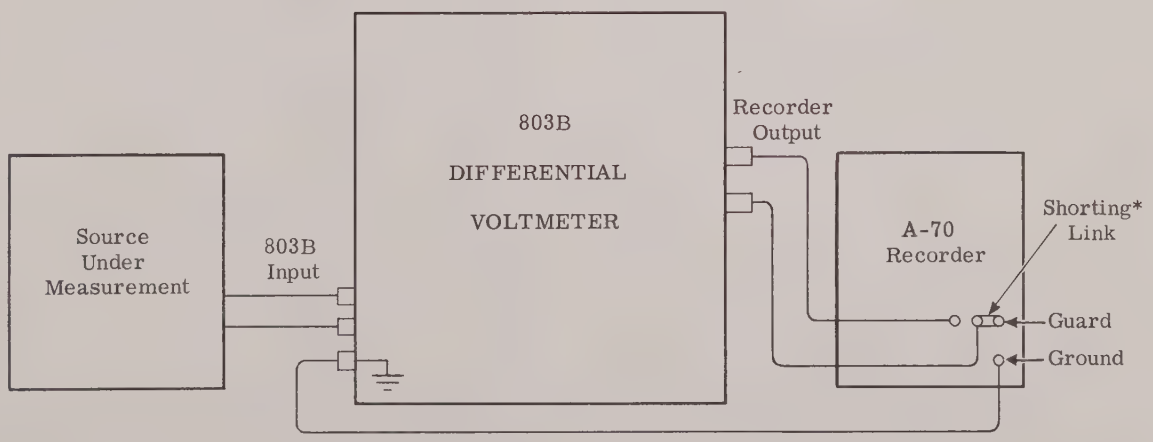
e. Set switches on the 803B voltmeter as follows:

| | |
|---|---|
| AC-DC polarity | + (positive) |
| RANGE | 50 |
| NULL | 10 |
| voltage read-out dials | 10.000 |

The 803B meter will indicate full scale deflection. This provides up to a maximum of approximately 20 millivolts at the output terminals depending on the setting of the output level control.

f. Turn the output level control until the recorder deflection obtained is that desired to correspond to full scale deflection of the 803B.

g. Remove the short from the input terminals of the 803B. The 803B and the recorder are now ready for combined use. Proceed as instructed under paragraph 2-7.




*If the recorder should be jittery, it is suggested that a 1,000 ohm resistor be substituted for the shorting link.

Figure 2-5. RECORDER RECOMMENDED CONNECTION DIAGRAM

## 2-9. MEASUREMENT OF HIGH RESISTANCES

One of the important features of the 803B voltmeter is its ability to be used as a megohmmeter for rapidly measuring high resistances from 1 megohm to 250,000 megohms. The following equation may be used to compute the resistance in megohms of an unknown connected to the input binding posts:

$$R_x = 10\left(\frac{E}{E_m} - 1\right) \text{ megohms,}$$

where:

$R_x$ = unknown resistance in megohms

$E$ = voltage indicated by voltage readout dials

$E_m$ = voltage indicated on meter

10 = megohms of input resistance of VTVM circuit on 10, 1, and 0.1 null range.

When connecting the unknown resistance to the input terminals, use short isolated leads to prevent measuring leakage resistance between the leads.

a. FROM 1 MEGOHM TO 500 MEGOHMS. For rapid measurement of resistances from 1 megohm to 500 megohms, proceed as follows:

(1) Perform preliminary procedure as stated in paragraph 2-3.

(2) Set RANGE switch to 500 and NULL switch to 10.

(3) Connect unknown resistance between input terminals.

(4) Adjust voltage readout dials for full scale meter deflection.

(5) Subtract 10.00 from the amount set on the voltage readout dials to find the resistance of the unknown in megohms.

b. FROM 500 MEGOHMS TO 5000 MEGOHMS. For rapid measurement of resistances from 500 to 5000 megohms, proceed as follows:

(1) Perform preliminary procedure as stated in paragraph 2-3.

(2) Set RANGE switch to 500 and NULL switch to 1.

(3) Connect unknown resistance between input terminals.

(4) Adjust voltage readout dials for full scale meter deflection.

(5) Subtract 1.00 from the amount set on the voltage readout dials and multiply the result by 10 to find the resistance of the unknown in megohms.

c. FROM 5,000 MEGOHMS TO 50,000 MEGOHMS. For rapid measurement of resistances from 5,000 to 50,000 megohms, proceed as follows:

(1) Perform preliminary procedure as stated in paragraph 2-3.

(2) Set RANGE switch to 500 and NULL switch to 0.1.

(3) Connect unknown resistance between input terminals.

(4) Adjust voltage readout dials for full scale meter deflection.

(5) Multiply the amount set on the voltage readout dials by 100 to find the resistance of the unknown in megohms.

d. FROM 50,000 MEGOHMS TO 250,000 MEGOHMS. To determine the value of an unknown resistance between 50,000 megohms and 250,000 megohms, proceed as follows:

(1) Perform preliminary procedure as stated in paragraph 2-3.

(2) Set RANGE switch to 500 and NULL switch to 0.1.

(3) Connect unknown resistance between input terminals.

(4) Adjust voltage readout dials for a convenient meter deflection.

(5) The resistance in megohms may be calculated by substituting the meter reading in volts ($E_m$, 0 to 0.1 volt on bottom scale) and the voltage readout dial setting ($E$) into the following equation:

$$R_x = 10\frac{E}{E_m} \text{ megohms}$$

## 2-10. NOTES ON MEASURING AC OR DC VOLTAGES

a. ADJUSTMENT OF 500 VOLT REFERENCE SUPPLY. The 500 volt DC reference supply may be adjusted (paragraph 2-3, step c) at any time deemed necessary without heed to the position of the switches and without removing any input or output connections. However, until the instrument has warmed up to an equilibrium temperature (about 1/2 hour), it should be adjusted prior to each specific measurement for best accuracy. When making prolonged measurements, allow one hour warmup time to insure that 500 volt reference supply does not shift during the final warmup phase.

b. GROUND LOOP PRECAUTIONS. Ground loop currents should be avoided to assure accuracy when making measurements. Potential differences are often found at different points on power system grounds. When this is the case, current may flow from the power system ground through the 803B and the equipment under measurement and back to the power system ground. To avoid this when system being measured is grounded, do not connect shorting link from lower input binding post to chassis ground post.

c. USE OF SHORTING LINK. A 0.47 uf capacitor (C1) is connected from the lower input binding post to the chassis ground post to reduce the effect of circulating AC currents from the transformer. In some cases, it is possible for C1 to acquire a charge. For example, C1 will become charged through leakage resistance over a period of time if there is no external connection to the input terminals and the controls are set as follows: range to 500, null to any null range, polarity to +, and voltage readout dials to several hundred volts. This condition may cause an error on low level measurements (under 5 volts) due to C1 discharging through the Kelvin - Varley divider. Connecting the shorting link from the lower input post to the ground post will discharge C1 and thus prevent an inaccurate indication.

## 2-11. NOTES ON MEASURING DC VOLTAGES

a. RECOMMENDED NULL RANGES FOR DC MEASUREMENTS. Certain null ranges are recommended for use with each setting of the RANGE switch for the following reasons. With the RANGE switch at 500 volts the last voltage readout dial (E) changes the reference voltage in steps of 0.01 volt. Therefore, the unknown voltage would have to be an exact multiple of 0.01 volt if a null is to be obtained on the 0.1 or 0.01 volt NULL range. Furthermore, it is unlikely that an unknown voltage of a few hundred volts will be stable within 10 millivolts. Finally, the regulation of the reference supply is approximately ±0.0025% (±0.0125 volt) for a 10% change in line voltage. Although this is more than adequate when the instrument is used in the recommended way, a badly fluctuating line voltage may cause the 803B to meter the regulation of its own 500 volt reference supply. For example, when measuring 500 volts a line change of 10% may cause the 500 volt reference supply to change as much as 12.5 mv. Although this is small, the 803B will indicate full scale for a change as little as 100 mv or 10 mv if attempting to use the 0.1 or 0.01 null ranges.

b. EFFECT OF AC COMPONENTS ON DC MEASUREMENTS. An AC component of several times the unknown DC may be present on the unknown and the 803B will always indicate well within the specifications for frequencies over a few hundred cycles. An AC component may have an adverse effect if it is of a low frequency or if it has a frequency that is a multiple or submultiple of the chopper frequency. A double section low pass filter (R201, C201, R202, and C202) is used at the input of the null detector to reduce any AC present on the DC being measured. At lower frequencies, this low pass filter is less effective and the magnitude of the AC component is more significant. When the frequency is very close to a multiple or submultiple of the chopper frequency (approximately 60 cycles), the meter needle will oscillate at the difference frequency. For example, a 60 cycle AC voltage that is 5% of the input voltage will cause an error of approximately 0.01% which is well within the specifications. At low frequencies other than 60 cycles, a larger AC component can be tolerated. Also, since the input attenuation is less for the more sensitive null settings, the accuracy may be affected only on the more sensitive null settings. If AC components that affect the accuracy are ever encountered, additional filtering will be required. For an AC of a single frequency, a twin-T filter is effective and has the advantage of low total series resistance. For an AC variable frequency, an ordinary low pass filter may be used. In either case, high quality capacitors of high leakage resistance should be used.

c. MEASUREMENT OF NEGATIVE DC VOLTAGES. Because of a polarity switch, voltages which are negative with respect to ground as well as the more commonly encountered positive voltages may be measured with equal facility. If the upper input post is connected to the metal case or line ground, either at the 803B or at the source under measurement, the accuracy of the voltmeter may be reduced. However, with the polarity switch the upper input post never has to be connected to ground. If the unknown voltage is grounded, always connect the grounded side to the lower input post (middle post) and use the polarity switch to obtain the proper result.

## 2-12. NOTES ON MEASURING AC VOLTAGES

a. ERRORS DUE TO DISTORTION. The AC to DC converter in the 803B is an average measuring device calibrated in RMS. The converter will put out a DC voltage that is proportional to 1.11 times the average value of the AC input voltage. Thus, if the input signal is not a true sinusoid, the 803B reading is probably in error because the ratio of RMS to average is usually not the same in a complex wave as in a sine wave. The magnitude of the error is dependent on magnitude of the distortion and on its phase and harmonic relationship with respect to the fundamental. Figure 2-6 indicates how the accuracy will be affected by various harmonics for different percentages of distortion. If the distortion present in the signal is composed of even harmonics and is less than 2%, the error between the 803B reading and true RMS is fairly minor. A larger error can occur if the distortion is composed of odd harmonics, especially the third harmonic. Note that for 2% of third harmonic distortion the error in the reading could range from 0 to 0.687%.

| Harmonic | % Distortion | % Error From True RMS* | |
|---|---|---|---|
| | | Maximum Positive | Maximum Negative |
| Any even harmonic | 0.1 | 0.000 | 0.000 |
| | 0.5 | 0.000 | 0.0001 |
| | 1.0 | 0.000 | 0.005 |
| | 2.0 | 0.000 | 0.020 |
| Third harmonic | 0.1 | 0.033 | 0.033 |
| | 0.5 | 0.167 | 0.168 |
| | 1.0 | 0.328 | 0.338 |
| | 2.0 | 0.667 | 0.687 |
| Fifth harmonic | 0.1 | 0.020 | 0.020 |
| | 0.5 | 0.099 | 0.101 |
| | 1.0 | 0.195 | 0.205 |
| | 2.0 | 0.380 | 0.420 |

*Error depends upon phase relationship between harmonic and fundamental, i.e. error can be any value between maximum positive and maximum negative, including zero.

Figure 2-6. PERCENT ERROR DUE TO HARMONIC DISTORTION

b. ERRORS DUE TO GROUNDING. In the 803B there is a 0.47 uf capacitor connected from the lower input terminal (middle post) to chassis ground. If it is desired to make measurements where the voltage to be connected to the lower input terminal is not at ground potential, a line cord adapter must be used to isolate the 803B chassis from line ground. Otherwise, the 0.47 uf capacitor would place an AC load on the circuit being measured.

c. INTERNAL CONVERTER NOISE. When the instrument is shorted in the AC mode, the converter may produce a residual noise output of approximately 100 uv. This noise voltage will cause an insignificant error as long as AC input signals of 1 mv or larger are applied to the instrument. Figure 2-7 shows a typical half wave of the signal voltage at the output of the converter amplifier. It is easily seen that the noise contributes very little to the average value of the signal and is well within the 2.7% accuracy of the instrument at 1 mv.

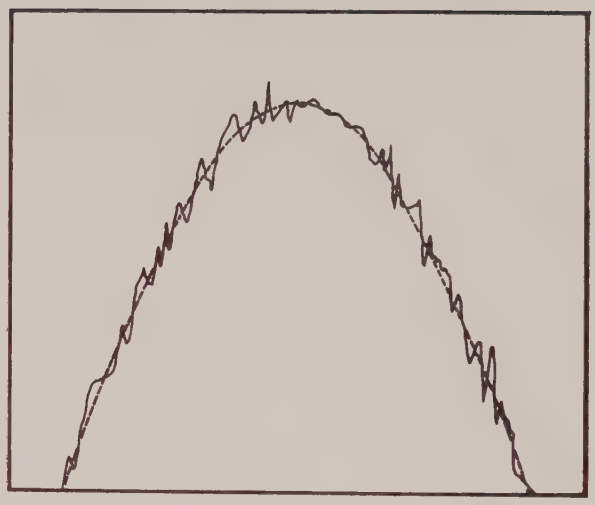


Figure 2-7. SIGNAL VOLTAGE WITH CONVERTER NOISE

# SECTION III

# THEORY OF OPERATION

## 3-1. GENERAL

a. Figure 3-1 shows the block diagram for the 803B AC/DC Differential Voltmeter. As seen in this figure, the circuit is mainly composed of an AC attenuator, an AC to DC converter, a DC attenuator, a null detector, a Kelvin-Varley divider, a range divider, a 500 volt DC reference power supply, and a null detector power supply. Refer to the functional schematic following Section VI for more detail. This schematic is designed to aid in the understanding of circuit theory and trouble-shooting. The signal flow is from left to right and the components are laid out in a functionally logical manner.

b. The overall operation of the voltmeter may be summarized as follows. The combination of the DC attenuator and the null detector form a very sensitive wide range DC VTVM. A DC differential voltmeter is created by connecting this DC VTVM in series with a precise internal DC voltage appearing across the Kelvin-Varley voltage divider. For AC measurements, the AC attenuator and the AC to DC converter unite to produce a DC voltage that is proportional to the AC input voltage. This DC voltage is then applied to the DC VTVM or the DC differential voltmeter.

c. To measure the approximate value of a DC voltage, the unknown voltage is connected to the DC VTVM. The DC attenuator reduces the maximum voltage for each range to a signal of 10 millivolts. This 10 mv signal is applied to the null detector and causes 100 microamperes to flow through the meter for full scale deflection. To accurately measure a DC voltage, the unknown voltage is connected to the DC differential voltmeter. The internal voltage is then adjusted by means of the Kelvin-Varley voltage divider until it matches the unknown voltage as indicated by the null detector.

d. All AC measurements are made by first converting the AC input voltage to a DC voltage. The AC to DC converter provides an output of 5 volts DC when the maximum voltage for each range is applied to the 803B. To measure the approximate value of an AC voltage, the output of the converter is connected directly to the DC VTVM. In this case, the DC attenuator always gives a reduction of 500 to 1. Thus 10 mv is supplied to the null detector for full scale deflection when the maximum voltage for each range is applied to the 803B. To accurately measure an AC voltage, the output of the converter is connected to the DC differential voltmeter which operates essentially the same as for DC measurements.

e. In order to provide for a more complete understanding of the 803B voltmeter, the following paragraphs describe each section of the circuit in detail.

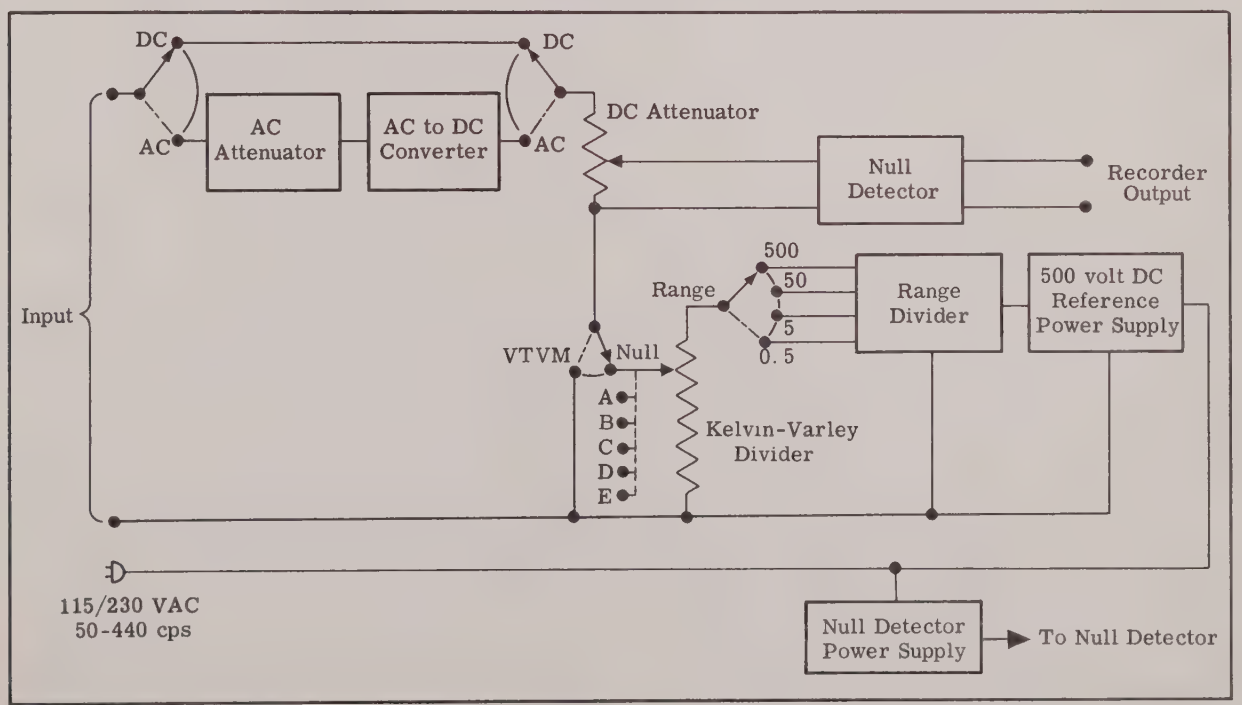



Figure 3-1. 803B AC/DC DIFFERENTIAL VOLTMETER BLOCK DIAGRAM

## 3-2. DC ATTENUATOR

a. In the DC VTVM mode, the resistance of the DC attenuator and thus the input resistance of the voltmeter is 50 megohms (R301 through R310) For full scale deflection 10 mv must be applied to the null detector. The necessary reduction is provided by four positions on the DC attenuator that are selected by range switch section S2C.

b. In the DC differential mode, the resistance of the DC attenuator is 10 megohms (R305 through R310) for the 10, 1, and 0.1 null ranges and 1 megohm (R306 through R310) for the 0.01 volt null range. However, this is not the input resistance of the voltmeter. The input resistance is determined by dividing the terminal voltage of the unknown by the amount of current drawn from the unknown. The current drawn from the unknown is equal to the difference between the unknown terminal voltage and the internally known voltage divided by the resistance of the DC attenuator. The equation for input resistance can hence be written as:

$$R_{in} = \frac{E_u}{I_u} = \frac{E_u R_a}{|E_u - E|} = \frac{E_s (R_a + R_s)}{|E_s - E|} - R_s$$

where:

$R_{in}$ = input resistance of voltmeter

$E_u$ = $E_s - I_u R_s$ = terminal voltage of unknown

$I_u$ = current drawn from unknown

$E_s$ = source voltage of unknown

$R_s$ = source resistance of unknown

$R_a$ = resistance of DC attenuator

$E$ = voltage indicated by voltage readout dials

$| \ |$ = absolute value (magnitude only)

Thus, the input resistance is infinite at null when E is equal to $E_u$ and $E_s$.

c. For full scale deflection of 10, 1, and 0.1 volts, the voltage difference (unknown voltage minus reference voltage) must be reduced by an attenuator. This reduction is provided by three positions on the DC attenuator that are selected by null switch section S3A. On the 0.01 volt null range, the voltage across the DC attenuator is fed directly to the null detector.

d. In the AC VTVM mode, null switch section S3A and AC-DC polarity switch section S5L provide connection to one position on the DC attenuator regardless of where the range switch is set. The converter output is thus reduced by a factor of 500 to 1. For full range input on each range, the 5 volt DC output of the converter is therefore reduced to the 10 mv required by the null detector for full scale deflection.

e. In the AC differential mode, the voltage difference (converter output voltage minus reference voltage) must be reduced by the DC attenuator before it is applied to the null detector. This reduction is provided by the same positions on the DC attenuator as for DC differential measurements.

## 3-3. NULL DETECTOR

a. GENERAL. The null detector is a fixed gain device containing three resistance-capacitance coupled voltage amplifier stages with a high amount of negative current feedback. With high negative current feedback, the output current is approximately equal to the signal voltage divided by the impedance of the feedback network regardless of the amplifier characteristics. The high negative feedback also makes the amplifier relatively insensitive to the gain changes in individual tubes due to aging and replacement. The output current from the null detector is indicated on a meter that has taut-band suspension. This suspension does away with all friction associated with meter pivot stickiness. Thus, any tendency for the meter pointer to stick at one point of the scale and then jump to another point is completely eliminated.

b. OPERATION. At the input to the null detector R201, C201, R202, and C202 form a double section low pass filter that reduces any AC component present on the DC voltage being measured. The difference between the voltage appearing at the output of the filter and the voltage developed across the feedback network is converted to an alternating voltage by G1, a 60 cycle chopper. This chopped voltage is amplified by V202, V203A, and V203B. During half the chopper cycle the output of the amplifier is clamped to approximate null detector common potential by G1 while during the other half the output is filtered by C212 to provide a DC current for the meter. When the chopper provides connection between contacts 1 and 7 a voltage is developed across feedback network R218 and R219 that is proportional to the meter (output) current. This feedback voltage effectively reduces the magnitude of the voltage that is chopped and applied to the input of the amplifier. The impedance of the feedback network (R218 and R219) is adjustable between 93.1 and 103.1 ohms. Since the output current is approximately equal to the signal voltage divided by the impedance of the feedback network, a 10 mv signal voltage indicates an output current of 97.8 to 107.4 ua. However, there is a loss due to finite amplifier gain and filtering that leaves the output current around 100 ua which can be set accurately by means of the feedback network. Thus, current feedback makes the output current essentially proportional to the signal voltage. For full scale deflection, a 10 mv signal voltage will cause 100 ua to flow through the meter.

c. EFFECT OF AC COMPONENTS. The only AC voltage component that will reduce the accuracy of the 803B is one that either saturates the chopper-amplifier or one that beats with the chopper frequency. Since the voltage required for saturation is greater than that required for beating, the null detector is most sensitive to an AC component with a frequency that is submultiple or a low multiple of the chopper frequency. However, this is easy to detect because the meter will beat at the difference frequency. The low pass filter at the input of the chopper-amplifier will attenuate any AC component.

The magnitude of the AC voltage appearing at the output of the filter depends on both its amplitude and frequency before filtering. For all practical purposes, one should never encounter any trouble above a few hundred cycles. Below this, the filter may not attenuate the AC component enough. However, this is not as bad as it appears. A 60 cycle AC voltage that is 5% of the input voltage will cause an error of approximately 0.01% which is well within specifications. If AC components that affect accuracy are ever encountered, additional filtering as set forth in paragraph 2-11 will eliminate the problem.

d. GAIN AND ZERO ADJUSTMENTS. Variable resistor R227 in the null detector power supply provides a means of adjusting the output current of the amplifier to zero when there is no input signal. The gain of the amplifier is adjusted by means of R219 in the feedback circuit.

e. RECORDER OUTPUT. The recorder output is picked off divider string R222, R1, and R223. Output level control R1 provides a means of adjusting the output voltage up to a maximum of approximately 20 millivolts at full scale deflection. The voltage at the output terminals is proportional to the meter reading.

## 3-4. 500 VDC REFERENCE POWER SUPPLY

a. When the 803B is used for AC or DC differential voltage measurements, an internal DC voltage is nulled or matched against the unknown voltage. An extremely accurate reference voltage is therefore required. This is obtained from the 500 volt DC reference supply.

b. A half wave voltage doubler consisting of five diodes (CR101, CR102, CR103, CR106, and CR107) and a filter network (R109, R110, C101, and C102) supply unregulated DC voltage to series passing tube V101. The voltage is regulated by comparing the voltage from reference tube V102 with a voltage tapped off a divider string (R123, R124, R121, and R2) in a differential amplifier V104. The output of differential amplifier V104 is fed to differential amplifier V105 which drives the grid of series passing tube V101. In this way the voltage drop across the passing tube is controlled such that the reference supply is maintained at 500 volts.

c. The reference voltage is passed to the Kelvin-Varley divider as follows for positive and negative DC settings of the AC - DC polarity switch. With the range switch set to 500, range switch sections S2B and S2F connect 500 volts to the Kelvin-Varley divider. In the 50, 5, and 0.5 volt positions, range resistors controlled by S2E divide the reference voltage to 50, 5, and 0.5 volts. These voltages are switched to the Kelvin-Varley divider by S2F. When the AC-DC polarity switch is set to AC, section S5G provides connection to only the range resistors that divide the reference to 5 volts. This 5 volts is then passed to the Kelvin-Varley divider by section S5H. The voltage applied to the Kelvin-Varley divider is always 5 volts for AC because the AC to DC converter always supplies up to a maximum of 5 volts to the DC attenuator. The 50, 5, and 0.5 volt range resistor networks are set accurately during calibration by means of R323, R326, and R329.

d. Variable resistor R121 is used during calibration to set the reference supply to 500 volts with calibrate control R2 set at its center of rotation. This allows the reference supply to be adjusted to 500 volts by me of the calibrate control at any time deemed necessary. With the operate-calibrate switch held at calibrate, a fixed percentage of the reference supply is compared to the precise potential of an internal standard cell or a Zener reference diode (in the /AG models). Any difference in potential is fed to the null detector so that the reference supply can be set with the calibrate control. The fixed percentage of the reference supply is set accurately during calibration by means of R318.

e. For proper operation a highly stable and accurate balance of amplification must be maintained between the two halves of differential amplifier V104. The filament supply for V104 must be regulated to maintain this balance. Regulation is provided by a transistor regulator which supplies constant voltage to the filament of V104. The filaments of the AC to DC converter tubes (V501 and V502) are also supplied by this regulator. A filtered full wave rectifier (CR104, CR105, and C103) which is regulated by a three transistor network (Q1, Q2, and Q3) supplies the regulated DC filament voltage. One side of the filaments are connected to the reference supply common (0 volts) while the other side is maintained at approximately 5.9 volts through the emitter-collector junction of Q3. The output of Q1 drives a Darlington connections of Q2 and Q3. Any variation in the unregulated supply causes a corresponding change in the voltage across the emitter-collector junction of Q3 so that the filament voltage of V104, V501, and V502 remains stable.

## 3-5. KELVIN-VARLEY DIVIDER

a. In order to null unknown voltages, each one of the four precision voltages available from the reference supply must be made adjustable. The five Kelvin-Varley decade resistor strings, R401 through R449 accomplish this function.

b. Note that each string, with the exception of the first, parallels two resistors of the string that preceeds it. Between the two wipers of S6 (voltage dial A) then, there is a total resistance of 40K (80K paralleled by 80K). With the RANGE switch in the 500 volt position, a total voltage of 100 volts DC will appear across these two wipers. Also, there will be 10, 1, and 0.1 volts DC across the wipers of S7, S8, and S9 respectively. Voltage dial E (S10) picks increments of 0.01 volts DC from the last decade. These voltages are reduced by a factor of 10 for each lower voltage range.

c. All the resistors of each decade are matched and all decades are matched for each instrument, providing an overall divider accuracy of 0.01% absolute.

d. With the NULL switch in any null range, the output of the Kelvin-Varley divider is connected in series with the DC attenuator as seen from the DC terminals. Also, the null detector operates with a common that is above or below (depending on the setting of the polarity switch) the potential of the lower input binding post by the amount set on the voltage readout dials.

## 3-6. AC TO DC CONVERTER

a. GENERAL. The AC to DC converter is essentially an operational amplifier containing three resistance-capacitance coupled amplifier stages with high negative feedback. The amplifier achieves a midband loop gain of approximately 70 db with a virtually flat frequency response from 20 cps to 10 kc. The high negative feedback makes the amplifier practically noise free and relatively insensitive to gain changes in individual tubes due to aging and tube replacement. At the output of the amplifier, full-wave rectification is used to return negative feedback to the grid of the first amplifier tube. Halfwave rectification and filtering is utilized to produce a DC voltage that is proportional to the average value of the AC input voltage. The output, however, is calibrated to indicate the rms value of a pure sine wave.

b. OPERATION. All AC measurements are made by first converting the AC input voltage to a DC voltage. The converter provides a DC output of 5 volts when full range voltage is applied to the 803B in each range. In the 5 volt AC position, range switch sections S2G and S2H connect the input binding posts directly to the converter input. In this case, the converter feedback is of such a value that the DC output voltage is equal to the rms value of the converter input AC voltage. In the 50 and 500 volt AC positions, input attenuators reduce the unknown AC by a factor of 10 and 100 respectively. This provides a maximum of 5 volts AC input to the converter for full range input to the 803B. In the 0.5 volt AC position, range switch section S2I connects to feedback resistors that allow the converter to produce a DC output that is equal to ten times the AC input. Thus, an output of 5 volts DC is provided for a full range input of 0.5 volts AC.

c. NULL INDICATIONS. When making AC differential measurements, the null range used times the applicable AC null multiplier must be used to represent full scale on the 803B meter. This is due to the way that the converter is constructed. When the range switch is set to 500, the AC attenuator reduces the input voltage by 100 to 1 before it is converted to DC and applied to the DC attenuator. Thus, the AC null multiplier for the 500 volt range position is X100. For example, when the range switch is set to 500 and the null switch is set to 0.01, full scale meter deflection represents a one volt (100 x 0.01) difference between the unknown voltage and the amount set on the voltage readout dials. By similar reasoning, the multiplier for the 50 and 5 volt positions are 10 and 1 respectively. When the range switch is set to the 0.5 volt position, the converter amplifies the input voltage by ten before it is converted to DC and applied to the input attenuator. Thus, the AC null multiplier for the 0.5 volt position is X0.1.

d. ADJUSTMENTS. For 0.5 volt converter gain, R536 at the output of the converter is adjusted. The gain of the amplifier for the 500, 50, and 5 volt ranges is adjusted by means of R541 in the feedback network. The high frequency response of the amplifier input is adjusted by means of C504 while C519 adjusts the high frequency response of the 0.5 volt feedback circuit. The attenuation of the 500 volt attenuator is adjusted with R534 and the attenuator high frequency response is adjusted with C523. The attenuation of the 50 volt attenuator is adjusted with R503 and the attenuator high frequency response is adjusted with C501.

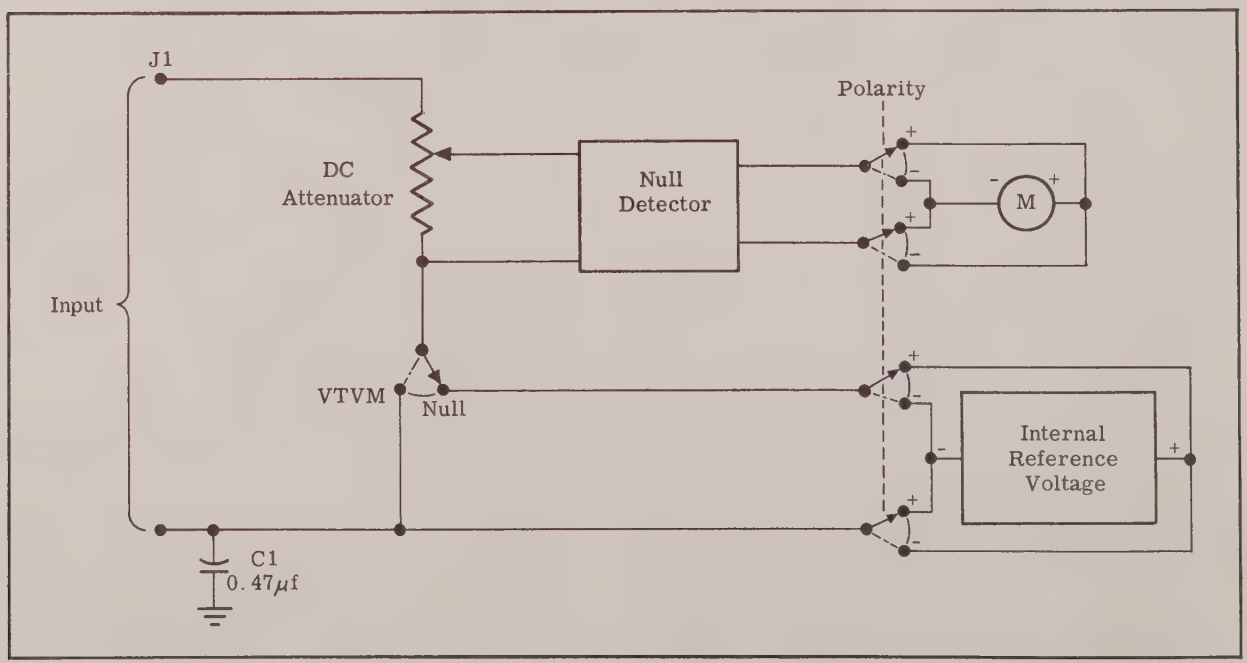



Figure 3-2. DC FUNCTION OF AC-DC POLARITY SWITCH

## 3-7. AC - DC POLARITY SWITCH.

a. The AC - DC polarity switch is provided for selecting either the AC or DC mode of operation. When the AC - DC polarity switch is set to AC, the AC to DC converter is switched into the circuit by sections S5I and S5K. Also, sections S5G and S5H are used to switch 5V DC to the Kelvin-Varley divider. When in the AC VTVM mode, S5L is used to provide the proper attenuation for the DC attenuator.

b. The AC - DC polarity switch may be set to either of two positions, positive or negative, for the DC mode of operation. As seen in figure 3-2, the AC - DC polarity switch does not just reverse the input posts when going from the positive to negative DC position. It reverses the meter and the internal reference supply. If the instrument did not contain positive and negative DC positions, the grounded side of any unknown voltage that is negative with respect to ground would have to be connected to the upper input binding post. This would ground the upper post and effectively place C1 (a 0.47 uf capacitor) across the input terminals. Even if C1 was disconnected, there would still be considerable capacitance across the input due to transformer winding capacitance and stray wiring capacitance. With this capacitance across the circuit being measured several problems could arise. The polarity switch provides equal convenience in measuring positive or negative voltages without the occurrence of these problems.

## 3-8. NULL DETECTOR POWER SUPPLY

A half wave rectifier system consisting of diode CR201 and a filter network (C214A, R228, and C214B) provides an unregulated DC voltage. This voltage is regulated by using an OA2 tube (V204) and a dropping resistor R229 in order to maintain a fairly stable B+ supply for the null detector. The chopper coil supply and the filament supply for V202 and V203 is obtained from a 6.3 volt winding. Variable resistor R227 along with divider resistors R225 and R226 provide a compensating voltage for the purpose of adjusting the null detector to zero with R227 when there is no signal input.

# SECTION IV

# MAINTENANCE

## 4-1. GENERAL

The 803B AC/DC Differential Voltmeter seldom requires any maintenance. Without extreme abuse, all that should be required is occasional cleaning, tube replacement, and calibration. Preventive maintenance consists only of preventing any leakage as discussed in paragraph 4-2. A discussion of troubleshooting along with a troubleshooting chart, component location diagrams, and a tube voltage chart are provided in paragraph 4-3. Paragraph 4-4 delineates the equipment and procedures necessary to calibrate the instrument.

## 4-2. PREVENTIVE MAINTENANCE

a. The accuracy of the 803B is adversely affected by excessive electrical leakage from the input of the null detector to either ground or the 500 volt reference supply. This leakage becomes evident when the RANGE switch is set to 500, NULL switch to 0.1, voltage readout dials to 490.00, and no input at the binding posts. The leakage indicated on the meter should be not more than one-tenth of full scale. Special care has been taken to prevent leakage across certain critical switch wafers and areas of some printed circuit boards due to moisture from condensation. The printed circuit boards have been coated with Humi-Seal 1B12 (manufactured by Columbia Technical Corp. of Woodside, N. Y.). The RANGE, NULL, OPERATE-CALIBRATE, and AC-DC polarity switches have been dipped in Dow Corning silicone oil. Accumulations of dust and foreign matter will cause internal leakage, and should be removed as often as necessary, depending on environmental operating conditions. Blowing the instrument out with low pressure, clean, dry air will remove most accumulations. Particular attention should be paid to the binding posts and wiring, and the NULL, RANGE, OPERATE-CALIBRATE, and AC-DC polarity switches.

b. After blowing the instrument out, the binding posts, insulators, and front panel may be cleaned with a rag saturated in anhydrous denatured ethyl alcohol. When necessary, wash all exposed dielectric surfaces of the NULL, RANGE, OPERATE-CALIBRATE, and AC-DC polarity switches with this alcohol using a small, stiff-bristled brush.

CAUTION

Do not use Metriclene, acetone, lacquer thinner, or any other methyl ethyl ketones since they will react with the Lexan rotor on the CTS plastic switches.

After washing, recoat the exposed switch insulating material with a solution of Dow Corning 200 having a viscosity between 5 and 20 centistokes. This prevents leakage due to moisture on these surfaces.

## 4-3. TROUBLESHOOTING

a. GENERAL. To assist in localizing most troubles which might occur, a troubleshooting chart (figure 4-1) lists the causes and remedies for a number of symptoms. Since failure of the 803B is usually due to tube failure, it is recommended that tube substitution be tried before any other tests are made. However, the 803B is conservatively designed and should require very infrequent tube replacement. At certain times, a check of the DC pin voltages in the tubes (figure 4-4) is also useful. As an aid to troubleshooting, all components may be located by referring to the figures shown in Section V. An understanding of the theory of operation (Section III) and frequent reference to the functional schematic will be of great value in troubleshooting.

WARNING

Use extreme care when working inside the instrument while it is on. All metal components on the null detector board will be at a voltage close to that indicated by the voltage readout dials.

| SYMPTOM | PROBABLE CAUSE | REMEDY |
|---|---|---|
| Drift of the 500 volt DC reference supply evidenced by the continual need for resetting with the CALIBRATE control. | V102, V104, or V105 defective. | Check V102, V104, and V105 by replacement. |
| | One of the sampling string resistors (R123, R124, R121) is changing value rapidly as the instrument warms up. | Locate faulty resistor by heating slightly with a soldering iron held near the resistor while observing the 500 volt DC calibration. |
| | Drifting standard cell EMF possibly caused by previous shorting or inverting of the cell. (803B and 803BR) | Allow time for the standard cell to stabilize. Several hours should be sufficient. |
| Cannot calibrate 500 volt DC reference supply. Meter cannot be brought to zero with CALIBRATE control. | Excessive aging of V102. | Check V102 by replacement. |
| | Out of calibration. | Recalibrate per paragraph 4-4. |
| | One or more resistors in 500 volt DC sampling string has shifted in value. | Recalibrate per paragraph 4-4 and observe stability for 48 hours. If 500 volt DC reference supply remains stable replacement of resistor is unnecessary. |
| | Standard cell EMF has shifted. (803B and 803BR) | Recalibrate instrument and observe stability of reference supply. Replacement of the standard cell may be necessary. |
| Measurements are out of tolerance on one range other than the 500 volt range. | A reference supply output range resistor on the range resistor printed circuit board is out of tolerance. | If the trouble occurs in the 50 volt range, R324 has shifted; in the 5 volt range, R325 or R327 has shifted; in 0.5 volt range, R328 or R330 has shifted. It may be possible to correct by recalibration. If not, replace faulty resistor. |
| Measurements are out of tolerance on all ranges other than the 500 volt range. | R320 or R321 has shifted in value. | It may be possible to correct all range voltages by recalibration. If not, replace faulty resistor. |
| Measurements are out of tolerance on any range when the Kelvin-Varley divider is dialed to any setting other than 499910. | One of the Kelvin-Varley divider resistors is out of tolerance. | Measure the voltage drop across each Kelvin-Varley resistor with another John Fluke Differential Voltmeter. Begin by setting RANGE switch to 500 volts and the voltage readout dials to 499.910. Reference to the schematic diagram will show that there should be 100, 10, 1, 0.1, and 0.01 volts respectively across each resistor of the A, B, C, D, and E decades, except for the two resistors of each decade that are paralleled by the following decade. Across these two resistors, there should be 50, 5, 0.5, and 0.05 volts, respectively. Measure all voltages ±0.05%. Remember that if one resistor in a decade has increased or decreased appreciably, the voltage drop across all other resistors in the decade will be slightly affected also. |
| Instrument is out of specifications on all ranges. | Resistors R306, R307, R308, R309 or R310 out of tolerance. | Check and replace faulty resistor. |

Figure 4-1. TROUBLESHOOTING (sheet 1 of 2)

| SYMPTOM | PROBABLE CAUSE | REMEDY |
|---|---|---|
| Meter rattle, drift, or error is observed on all null ranges. | V202 or V203 faulty. | Check V202 and V203 by replacement. |
| | Chopper G1 faulty. | Replace chopper. |
| | Moisture or dirt on printed circuit boards or switches. | Clean instrument. |
| NOTE: Assuming all DC measurements are normal, the following symptoms are common to AC measurements only. | | |
| Measurements are out of tolerance on 500 volt AC range only. | Out of calibration. | Recalibrate per paragraph 4-4d (1) and 4-4d (6). DC calibration is not necessary. |
| | One or more resistors in 500 volt AC attenuator has shifted in value. | Recalibrate per paragraph 4-4d (1) and 4-4d (6). DC calibration is not necessary. Recheck calibration after 48 hours and if attenuator has remained stable, replacement of resistor is unnecessary. If attenuator does not remain stable, or calibration is not possible, replace faulty resistor. |
| Measurements are out of tolerance on 50 volt AC range only. | Out of calibration. | Recalibrate per paragraph 4-4d (1) and 4-4d (8). DC calibration is not necessary. |
| | One or more resistors in 50 volt AC attenuator has shifted in value. | Recalibrate per paragraph 4-4d (1) and 4-4d (8). DC calibration is not necessary. Recheck after 48 hours and if attenuator has remained stable, replacement of resistor is unnecessary. If attenuator does not remain stable or if calibration is not possible, replace faulty resistor. |
| Measurements out of tolerance on all AC ranges. | Out of calibration. | Recalibrate per paragraph 4-4d. |
| | V501 or V502 faulty. | Check V501 and V502 by replacement. |
| Measurements out of tolerance at a specific frequency. | Out of calibration. | Recalibrate per paragraph 4-4d. |
| | Faulty frequency compensation capacitor. | Locate faulty capacitor and replace. If trouble occurs on all ranges, check C504. If trouble occurs on 500 volt range only, check C523, C524, and C525. If trouble occurs on 50 volt range only, check C501 and C502. If trouble occurs on 500, 50, and 5 volt range, check C521. If trouble occurs on 0.5 volt range check C519 and C520. |

Figure 4-1. TROUBLESHOOTING (sheet 2 of 2)

b. TUBE REPLACEMENT. Replacement of tubes will not normally necessitate complete recalibration of the 803B. If V202 or V203 is replaced, calibrate the null detector as set forth in paragraphs 4-4c. (1) and 4-4c. (2). Replacement of V101, V102, V104, or V105 will necessitate calibration of the reference supply per paragraphs 4-4c. (1) and 4-4c. (3). If V501 or V502 is replaced, calibrate the AC to DC converter as in paragraph 4-4d.

c. COMPONENT REPLACEMENT. Should it ever become necessary to replace a component on a printed circuit board, proceed as follows:

(1) Clean soldered area around component with methyl ethyl ketone.

(2) Remove part and install new component.

(3) Remove flux with du Pont Freon PC.

(4) Allow to dry for 10 minutes. When it is cool or humid, it may be necessary to place area under a lamp to ensure thorough drying.

(5) Coat any uncoated areas around R305 through R310 on the Range Resistor Board and around the input to the Null Detector Board (tube V202, EF-86/6267, and chopper) with Humi-Seal 1B12.

d. KELVIN-VARLEY RESISTOR REPLACEMENT. All the resistors of the first three decades (R401 to R406, R407 to R417, and R418 to R428) are matched and these three decades are matched for each instrument. If it becomes necessary to replace a Kelvin-Varley resistor, the instrument model and serial number as marked on the name plate and all information stamped on the

resistor must be sent to Fluke along with the purchase order for the particular resistor needed. This ensures that a resistor compatible with the matched resistor group within the instrument is used. The Kelvin-Varley resistors are very stable and precise; resistance is clearly defined; therefore, they must be handled with care. This is especially true of the varnished-dipped-card resistors.

CAUTION

Pick up card resistors between ends of card. Never touch the wire on the cards as damage to the resistor could possibly result.

e. STANDARD CELL PROBLEMS. The standard cell of the 803B and 803BR deserves special consideration if it is suspected of being faulty:

(1) The standard cell used in the Model 803B and 803BR is a miniature low hysteresis unit which has excellent long term stability and negligible temperature hysteresis. (Hysteresis is a temporary increase in EMF immediately following a decrease in temperature; this effect should not be confused with temperature coefficient). Under normal conditions this cell should last from 8 to 15 years. In rare instances, failure has occurred in less than 2 years. End of life is usually marked by an increase in temperature hysteresis effect. That is, reading errors in excess of 0.025% will result when the same voltage is read with the 803B hot and cold. Should replacement of the cell become necessary for any reason, the instrument must be recalibrated (basic 500 volt range only), since the EMF of different cells may be different by as much as 0.05% and each instrument is calibrated to its own particular standard cell. Refer to the recalibration instructions in this case.

(2) Failure of the standard cell may occur if subjected to below freezing temperature. The electrolyte will freeze at 1°F and operation below 32°F is definitely not recommended. The life of the cell also will be greater is the 803B is not operated at elevated temperature. The 8 to 15 year figure holds for operation of the instrument in normal room temperature.

(3) The EMF of the standard cell will change if the cell has been inverted, or if the cell has been inadvertently short-circuited. If the EMF has changed, the 803B will naturally be out of calibration on all ranges. In either case, the cell will return to its original EMF. If the cell were inverted or shorted for only a few seconds, the 803B should be able to measure voltages within specifications after several hours recovery time.

f. DECIMAL LAMP REPLACEMENT. The decimal lamps are normal 6.3 volt pilot bulbs. To prolong their life these bulbs are operated from a 5 volt transformer winding. However, these bulbs do occasionally fail. To replace, proceed as follows:

(1) On cabinet models, remove screws at back of cabinet and slide instrument out of case.

(2) Remove four screws that hold front panel assembly to chassis.

(3) Being careful to avoid wiring damage, gently lift front panel assembly from instrument and set face down in front of instrument.

(4) Remove screws holding range resistor printed circuit board and Kelvin-Varley printed circuit board to front panel assembly.

(5) Push these printed circuit boards aside enough to allow access to pilot light holders.

(6) Remove pilot light holder from bracket by applying pressure to each side of holder.

(7) Remove cardboard light shield and replace pilot light.

(8) On rack models, remove screws holding cover of instrument and set cover aside.

(9) Remove pilot light holder from bracket by applying pressure to each side of holder.

(10) Remove cardboard light shield and replace pilot light.

## 4-4. CALIBRATION

a. GENERAL. The 803B can be calibrated as often as deemed necessary. However, it is recommended that Zener diode models be calibrated every three months and standard cell models be calibrated every six months. For special applications where extreme accuracy is required, it may be desired to calibrate the instrument more frequently. Calibration should be accomplished in a draft-free area with ambient temperature of 72 (±3)°F for maximum accuracy under laboratory operating conditions.

| RECOMMENDED EQUIPMENT | SPECIFICATIONS REQUIRED |
|---|---|
| DC CALIBRATION:<br><br>Fluke 301C or 301E Power Supply<br><br>Eppley Standard Cell 100A<br><br>Leeds and Northrup 2430A<br><br>Electro Scientific Industries Special Precision Voltage Divider X194<br><br>Any single pole push button switch with fine silver contacts<br><br>Any double pole push button switch with fine silver contacts<br><br>Any 5.6 (±10%) Ω resistor<br><br>Any 56 (±10%) Ω resistor | The equipment used must provide 500, 50, 5, and 0.5 volts with an accuracy of 0.01%. |
| AC CALIBRATION:<br><br>Any Fluke Model 800 series Differential Voltmeter<br><br>Fluke 301C or 301E Power Supply<br><br>Elin VC - 555A Oscillator<br><br>Fluke 540A Transfer Standard | The equipment used must provide 500, 50, 5, and 0.5 volts AC at 400 cycles and 10 kilocycles with an accuracy of at least 0.05% and with less than 0.1% total harmonic distortion. |

Figure 4-2. CALIBRATION EQUIPMENT

b. The calibration procedure is divided into two parts: DC Differential Voltmeter calibration (paragraph 4-4c) and AC to DC Converter calibration (paragraph 4-4d). The DC Differential Voltmeter calibration must be performed prior to AC to DC Converter calibration. The recommended equipment and specifications required for calibration are shown in figure 4-2. All controls may be located with the aid of figure 4-3. The recommended calibration set-up is shown in figure 4-5 for DC Differential Voltmeter Calibration and in figure 4-6 for AC to DC Converter calibration.

c. DC DIFFERENTIAL VOLTMETER CALIBRATION. The Bureau of Standards will certify the Eppley 100A

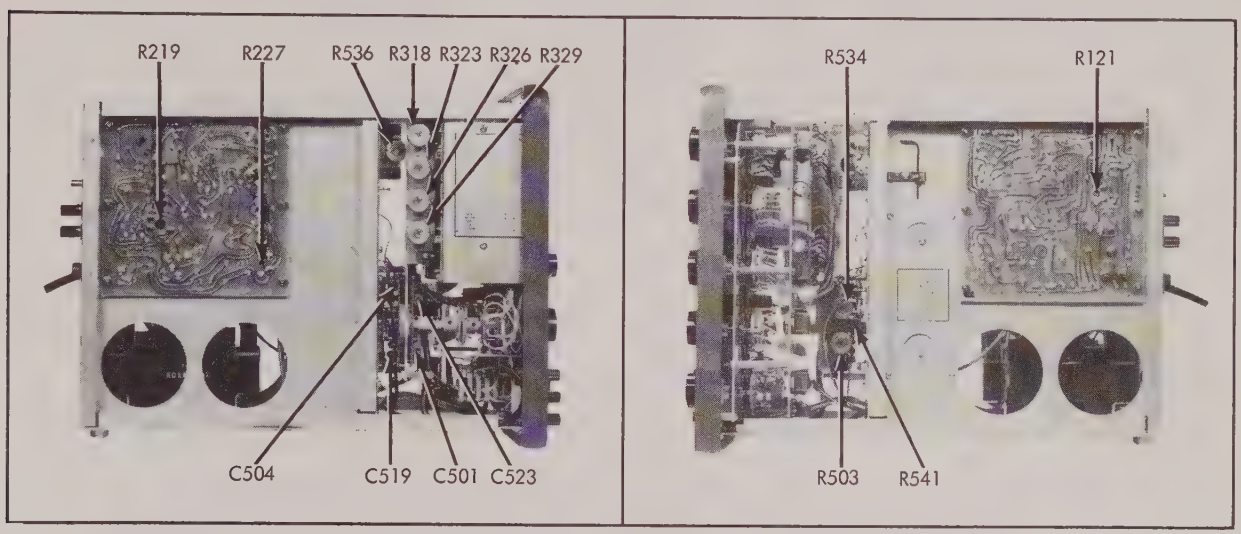



Figure 4-3. ADJUSTMENT LOCATIONS

| Symbol & Type | Pin 1 | Pin 2 | Pin 3 | Pin 4 | Pin 5 | Pin 6 | Pin 7 | Pin 8 | Pin 9 |
|---|---|---|---|---|---|---|---|---|---|
| V101, 6BQ5 | No Conn. | 495 | 500 | Heater voltage 6.3 volts ac | | No Conn. | 680 to 730 | No Conn. | 680 to 730 |
| V102, OG3 | 85 | 0 | Int. Conn. | 0 | 85 | Int. Conn. | 0 | No Pin | No Pin |
| V104, 12AX7 | 217 | 84 | 86 | Heater voltage 5.9 volts dc | | 217 | 84 | 86 | See Pin 4 & 5 |
| V105, 12AX7 | 495 | 217 | 220 | Heater voltage 6.3 volts ac | | 500 | 217 | 220 | |
| V202, EF-86/6267 | 35 | 0 | 1.2 | Heater voltage 6 volts ac | | 50 | 0 | 1.2 | - |
| V203, 6AW8 | 0.9 | - | 100 | Heater voltage 6.3 volts ac | | 0.7 | - | 20 | 40 |
| V204, OA2 | 150 | 0 | Int. Conn. | 0 | 150 | Int. Conn. | 0 | No Pin | No Pin |
| V501, 6EJ7 | 1.3 | - | 1.3 | Heater voltage 5.9 volts dc | | 0 | 149 | 93 | 1.3 |
| V502, 6AW8 | 28 | - | 197 | | | 1.8 | - | 103 | 70 |

This chart is to be used under the following conditions: (a) RANGE switch set to 500; (b) NULL switch set to VTVM: (c) all voltage readout dials set to zero; (d) line voltage at 115/230 volts, 50 - 60 cycles; and (e) all measurements made with a VTVM from negative binding post to specified terminal.

Figure 4-4. TUBE VOLTAGE CHART

cell used in the calibration set-up to only 0.01%. However, the standard cell may be maintained to 0.002% if treated with care and not subjected to sudden temperature changes. For reasonable certainty of 0.002% cell accuracy, the certified value should be known to six places. Since the ESI voltage divider is accurate within 0.005%, the overall DC calibration system accuracy is between 0% and 0.007%.

(1) Preliminary Calibration Procedure.
(a) Set 803B meter to zero with mechanical adjustment screw on front of meter case.
(b) Set switches on 803B as follows:

| | |
|---|---|
| RANGE | 500 |
| NULL | VTVM |
| AC - DC polarity | + (positive) |
| all voltage read-out dials | 0 (zero) |

(c) Set power switch to ON and allow 803B to warmup to equilibrium temperature (about 1 hour) inside its case.
(d) Set up necessary equipment to provide DC voltages of 500, 50, 5, and 0.5 volts DC with an accuracy of 0.01%. Proceed as follows: connect equipment as shown in figure 4-5; turn on all test equipment and allow it to warmup to equilibrium temperature (about 1/2 hour); set proper standard cell voltage on ESI divider; apply 500 volts DC into divider from power supply; set ESI divider to 500 and zero galvanometer by varying output of power supply while depressing coarse and then coarse and fine pushbutton switch; voltages of 500, 50 5, and 0.5 volts DC (±0.01%) are made available at output posts by merely changing position of voltage selector switch on voltage divider.
(e) Connect chassis ground binding post to line ground.
(f) On rack models, all controls may be easily reached through access holes.
(g) On cabinet models, R121, R219, and R227 may be reached through the ventilation holes. To prevent shorting control to chassis ground, use an insulated screwdriver to reach these controls. To reach calibration controls at the front of the cabinet models the instrument must be slid partly out of its cabinet.

(2) Null Detector Calibration.
(a) Perform preliminary calibration procedure as stated in paragraph 4-4c (1).
(b) Adjust null detector ZERO ADJ control R227 until meter indicates zero.
(c) Apply 500 volts DC (±0.01%) to voltmeter.
(d) Adjust VTVM GAIN ADJ control R219 for full scale deflection.

(3) 500 VDC Reference Supply Calibration.
(a) Perform preliminary calibration procedure as stated in paragraph 4-4c (1).
(b) Center CALIBRATE control at its center of rotation.
(c) Set NULL switch to 10 and voltage readout dials to 499.910.
(d) Apply 500 volts DC (±0.01%) to voltmeter.
(e) Adjust 500V ADJ control R121 for a null.
(f) Set NULL switch to 0.1 volt.
(g) Null meter by adjusting CALIBRATE control.
(h) Advance OPERATE-CALIBRATE switch against spring tension to CALIBRATE and null meter by adjusting REF CAL ADJ control R318.

(4) Range Divider Calibration.
(a) Perform preliminary calibration procedure as stated in paragraph 4-4c (1).
(b) Set switches on 803B as follows:

| | |
|---|---|
| RANGE | 50 |
| NULL | 0.01 |
| voltage read-out dials | 49.9910 |

(c) Apply 50 volts DC (±0.01%) to voltmeter.
(d) Null 803B meter by adjusting 50 V DC ADJ control R323.
(e) Set RANGE switch to 5 volts.
(f) Apply 5 volts DC (±0.01%) in voltmeter.
(g) Null 803B meter by adjusting 5 V DC ADJ control R326.
(h) Set RANGE switch to 0.5 volts.
(i) Apply 0.5 volts DC (±0.01%) to voltmeter.
(j) Null 803B meter by adjusting 0.5 V DC ADJ control R329.
This completes the DC Differential Voltmeter calibration.

d. AC TO DC CONVERTER CALIBRATION. The DC Differential Voltmeter section of the 803B must be within specifications before the AC to DC Converter can be accurately calibrated. The AC to DC Converter must be calibrated in the following order.

(1) Preliminary Calibration Procedure.
(a) Perform DC Differential Voltmeter calibration as in paragraph 4-4c.
(b) Set switches on 803B as follows:

| | |
|---|---|
| RANGE | 500 |
| NULL | 0.01 |
| AC-DC polarity | AC |
| voltage read-out dials | 499.910 |

(c) Set up the necessary equipment to provide 500, 50, 5, and 0.5 volts AC with an accuracy of at least ±0.05% at frequencies of 400 cycles and 10 kilocycles, with less than 0.1% total harmonic distortion. Proceed as follows: connect equipment as shown in figure 4-6; turn on all test equipment and allow it to warm up to equilibrium temperature (about 1/2 hour); adjust DC power supply voltage until differential voltmeter indicates RMS value of AC voltage required; apply output of DC supply to 540A and null galvanometer by adjusting internal reference supply voltage; apply output of AC oscillator to 540A and null galvanometer by adjusting AC oscillator voltage; the output of the Elin Oscillator now equals the required AC voltage.

(2) 0.5 VAC Converter Gain Adjustment.
(a) Set RANGE switch to 0.5 volt position.
(b) Apply 0.5 volts AC at 400 cycles to voltmeter.
(c) Adjust 0.5 VAC GAIN ADJ control R536 until the meter needle is within ±50 microvolts (1/2 major division) of null.

(3) 5 VAC Converter Gain Adjustment.
(a) Set RANGE switch to 5 volt position.
(b) Apply 5 volts AC at 400 cycles to voltmeter.
(c) Adjust 5 VAC GAIN ADJ control R541 for a null.

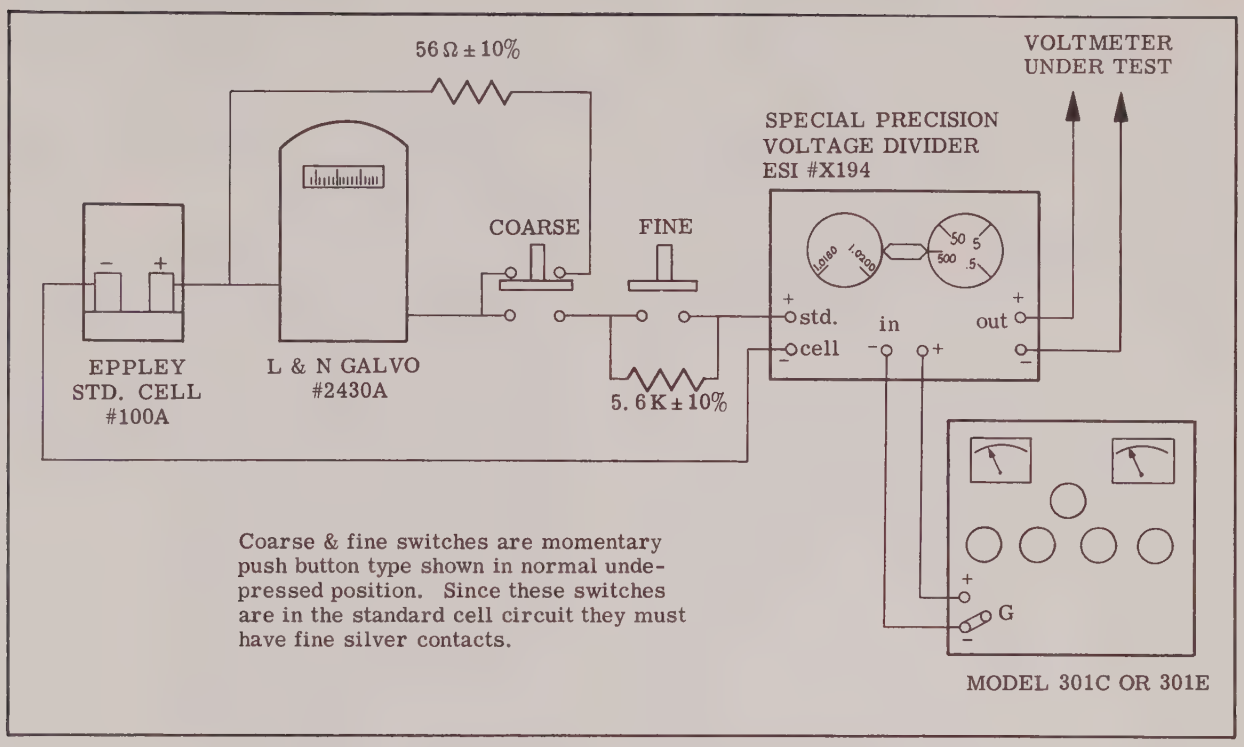

56 Ω ± 10%
VOLTMETER UNDER TEST
SPECIAL PRECISION VOLTAGE DIVIDER ESI #X194
COARSE
FINE
EPPLEY STD. CELL #100A
L & N GALVO #2430A
5.6K ± 10%
std. cell
in
out
G
Coarse & fine switches are momentary push button type shown in normal undepressed position. Since these switches are in the standard cell circuit they must have fine silver contacts.
MODEL 301C OR 301E

Figure 4-5. DC DIFFERENTIAL VOLTMETER CALIBRATION SET-UP

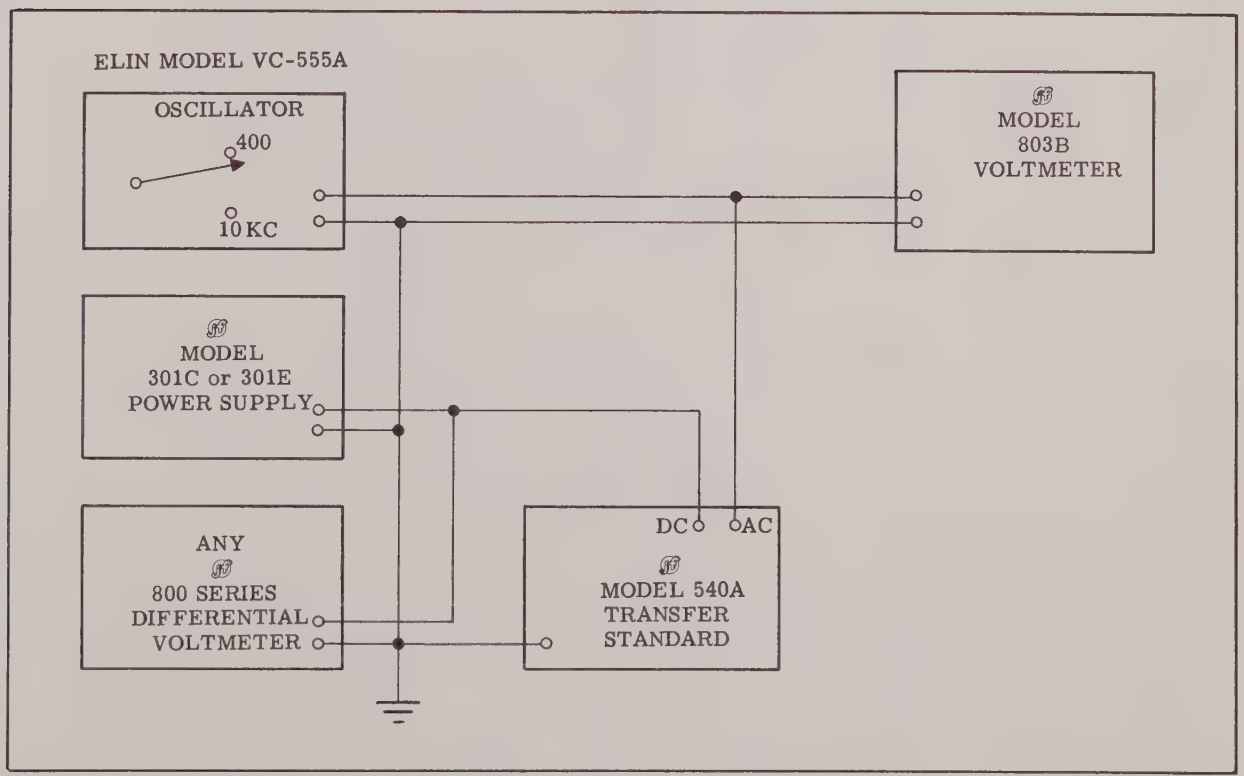



Figure 4-6. AC TO DC CONVERTER CALIBRATION SET-UP

(4) 5 VAC High Frequency Adjustment.
(a) Apply 5 volts AC at 10 kilocycles to voltmeter.
(b) Adjust 5 VAC HF TRIM control C504 for a null.

(5) 0.5 VAC High Frequency Adjustment.
(a) Set RANGE switch to 0.5 volt position.
(b) Apply 0.5 volt AC at 10 kilocycles to voltmeter.
(c) Adjust 0.5 VAC HF TRIM control C519 for a null.

(6) 500 VAC Attenuator Adjustment.
(a) Set RANGE switch to 500 volt position.
(b) Apply 500 volts AC at 400 cycles to voltmeter.
(c) Adjust 500 VAC ATTENUATOR control R534 for a null.

(7) 500 VAC High Frequency Adjustment.
(a) Apply 500 volts AC at 10 kilocycles to voltmeter.
(b) Adjust 500 VAC HF TRIM control C523 for a null.

(8) 50 VAC Attenuator Adjustment.
(a) Set RANGE switch to 50 volt position.
(b) Apply 50 volts AC at 400 cycles to voltmeter.
(c) Adjust 50 VAC ATTENUATOR control R503 for a null.

(9) 50 VAC High Frequency Adjustment.
(a) Apply 50 volts AC at 10 kilocycles to voltmeter.
(b) Adjust 50 VAC HF TRIM control C501 for a null.

This completes the AC to DC Converter calibration.

# SECTION V

# LIST OF REPLACEABLE PARTS

5-1. GENERAL

a. The following seven assembly lists describe all normally replaceable parts of the Model 803B, 803BR, 803B/AG, and 803BR/AG Differential AC/DC Voltmeters. Each list has a corresponding illustration on which the parts for that list are pointed out. Parts are called out on both lists and illustrations by reference designations from the schematic diagram. Those parts (mechanical) which have no reference designation are shown on the illustrations by Fluke stock number.

b. A Use Code column is provided to identify certain parts that have been added, deleted, or modified during production of the 803B. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting the Use Code Effectivity List at the end of this section.

5-2. HOW TO OBTAIN PARTS

a. Standard components have been used whenever possible. Thus, most parts may be obtained locally. However, special components are used in some instances. All parts manufactured or altered by Fluke and all parts for which Fluke controls the design are designated by an asterisk preceding the Fluke stock number. All structural parts and special parts should be purchased from your local Fluke representative or from the factory.

b. When ordering parts always include:

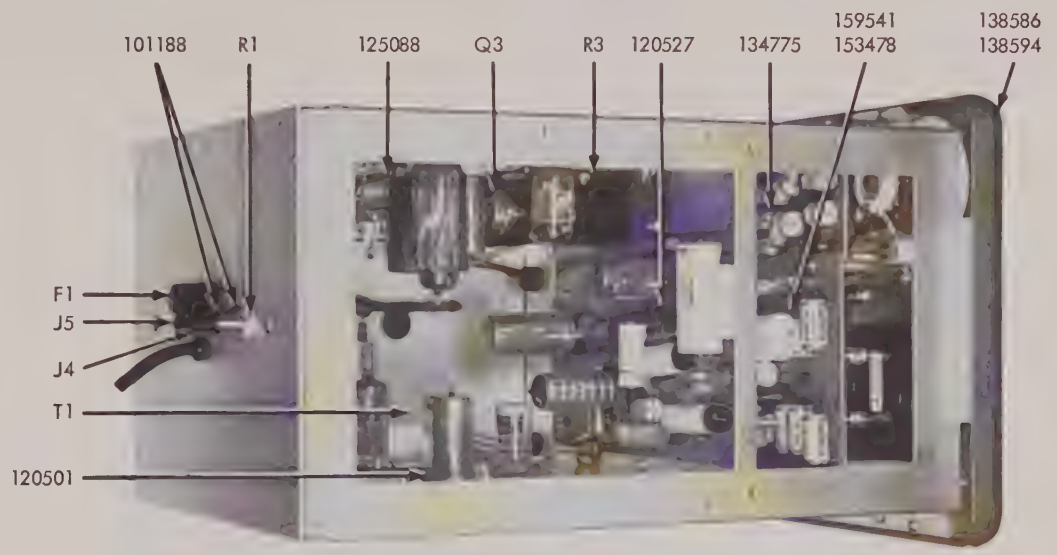
(1) Reference designation, description, and Fluke stock number.

(2) Instrument model and serial number.

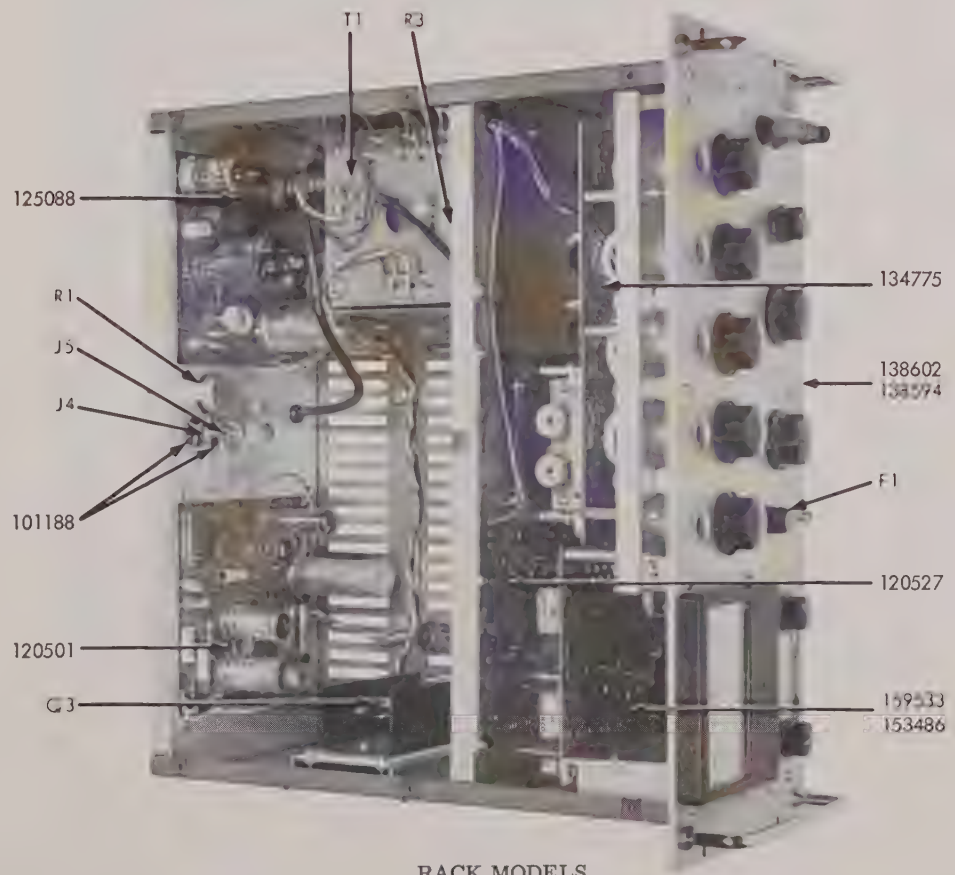
(3) Most structural parts are not listed. In this case, give complete description, function, and location for the part.

| REFERENCE DESIGNATION | DESCRIPTION | FLUKE STOCK NO. | USE CODE |
|---|---|---|---|
| | Final Assembly | | |
| | (Cabinet model, standard cell option) | *803B | |
| | (Rack model, standard cell option) | *803BR | |
| | (Cabinet model, Zener diode option) | *803B/AG | |
| | (Rack model, Zener diode option) | *803BR/AG | |
| | Front Panel Assembly (See Figure 5-2) | | |
| | Model 803B | *138586 | |
| | Model 803BR | *138602 | |
| | Model 803B/AG | *138594 | |
| | Model 803BR/AG | *138610 | |
| | Reference Supply Board Assembly (See Figure 5-3) | | |
| | | *803B-449 | E |
| | | *803BR-412 | F |
| | | *125088 | L |
| | Null Detector Board Assembly (See Figure 5-4) | | |
| | | *120501 | Q |
| | | *150029 | R |
| | Range Resistor Board Assembly (See Figure 5-5) | | |
| | Model 803B | *120477 | AC |
| | | *159541 | AD |
| | Model 803BR | *120923 | AC |
| | | *159533 | AD |
| | Model 803B/AG | *120972 | AC |
| | | *153478 | AD |
| | Model 803BR/AG | *120485 | AC |
| | | *153486 | AD |

| REFERENCE DESIGNATION | DESCRIPTION | FLUKE STOCK NO. | USE CODE |
|---|---|---|---|
| | Kelvin-Varley Resistor Board Assembly (See figure 5-6) | *134775 | |
| | Converter/AC Range Switch Assembly (See figure 5-7) | *120527 | |
| F1 | Fuse, 1.5 ampere, slow-blowing (for 115 volt operation) | 109231 | |
| | Fuse, 0.75 ampere, slow-blowing (for 230 volt operation) | 109256 | |
| J4, J5 | Binding post, black | 101204 | I |
| | Binding post, red | 104158 | J |
| | Binding post insulator, red (4 used) | 101188 | G |
| | Binding post insulator, dual, black (2 used) | 135053 | H |
| Q3 | Transistor, germanium, PNP, special purpose, 2N301W | *116707 | |
| R1 | Resistor, variable, wirewound, 5K ±10%, 2W | 111583 | |
| R3 | Resistor, precision power (803B/AG and 803BR/AG. Optimum value is selected at factory to match Zener diode. When ordering, include date and serial number listed on Range Resistor Board decal.) | | |
| R6, R7 | Resistor, wirewound, 6K ±5%, 5W | *113449 | K |
| T1 | Transformer, power | *801B-651 | C |
| | Transformer, power | *125237 | D |
| | Transformer, power | *149088 | AG |
| | Transformer, power | *135012 | AH |
| | Transformer, power | 216689 | AO |
| | Line cord, 3 wire | 102822 | |
| | Rubber foot | 101253 | |
| | Nylon foot | 102921 | |
| | Case Assembly (Cabinet model) | *120386 | |
| | Handle, flexible black vinyl, 5-1/2" (Cabinet model) | 407-101 | |




CABINET MODELS




RACK MODELS

Figure 5-1. FINAL ASSEMBLY

| REFERENCE DESIGNATION | DESCRIPTION | FLUKE STOCK NO. | USE CODE |
|---|---|---|---|
| | Front Panel Assembly | | |
| | Model 803B | *138586 | |
| | Model 803BR | *138602 | |
| | Model 803B/AG | *138594 | |
| | Model 803BR/AG | *138610 | |
| B1 | Standard cell | 135160 | |
| C1 | Capacitor, mylar, 0.47 uf ±10%, 600V | 105494 | |
| DS1, DS2, DS3, DS4 | Lamps, decimal | 102855 | |
| | Light holder | 100131 | |
| | Light shield | 101428 | |
| | Light lens | 103440 | |
| J1, J2, J3 | Binding post, black | 101204 | G |
| J2 | Binding post, black | 101204 | H |
| J1, J3 | Binding post, red | 104158 | H |
| | Binding post insulator, red (4 used) | 101188 | G |
| | Binding post insulator, dual, black (1 used) | 135053 | H |
| | Binding post insulator, black (2 used) | 135061 | H |
| | Binding post spacer | 101212 | |
| | Shorting link | 101220 | |
| M1 | Meter, 100-0-100 microamp (M32, M49 and 111211 are interchangeable) | *M32, M49, or 111211 | |
| R2 | Resistor, variable, dual section wirewound, 1K and 100 ohm ±10%, 2W | 112714 | |
| S1 | Switch, power | 114850 | |
| S2 | Switch, range, DC section | *120642 | |
| | | *125138 | |
| S3 | Switch, null | *120659 | |
| S4 | Switch, operate-calibrate | *134973 | |
| S5 | Switch, AC-DC polarity | *120691 | |
| S6 | Switch, voltage dial A | *134817 | |
| S7, S8, S9 | Switch, voltage dials B, C, and D | *134841 | |
| S10 | Switch, voltage dial E | *134825 | |
| | Knob | 101287 | AM |
| | | 188824 | AN |
| | | 170068 | AN |
| | Knob | 101121 | AM |
| | | 171660 | AN |
| | Knob | 101311 | AM |
| | | 188524 | AN |
| | | 170050 | AN |
| | Knob | 103614 | AM |
| | | 188532 | AN |
| | | 170050 | AN |
| | Voltage dial plates (cabinet model) | *107029 | |
| | (rack model) | *107011 | |
| | Handle, 6" chrome plated (rack models only) | 101717 | |

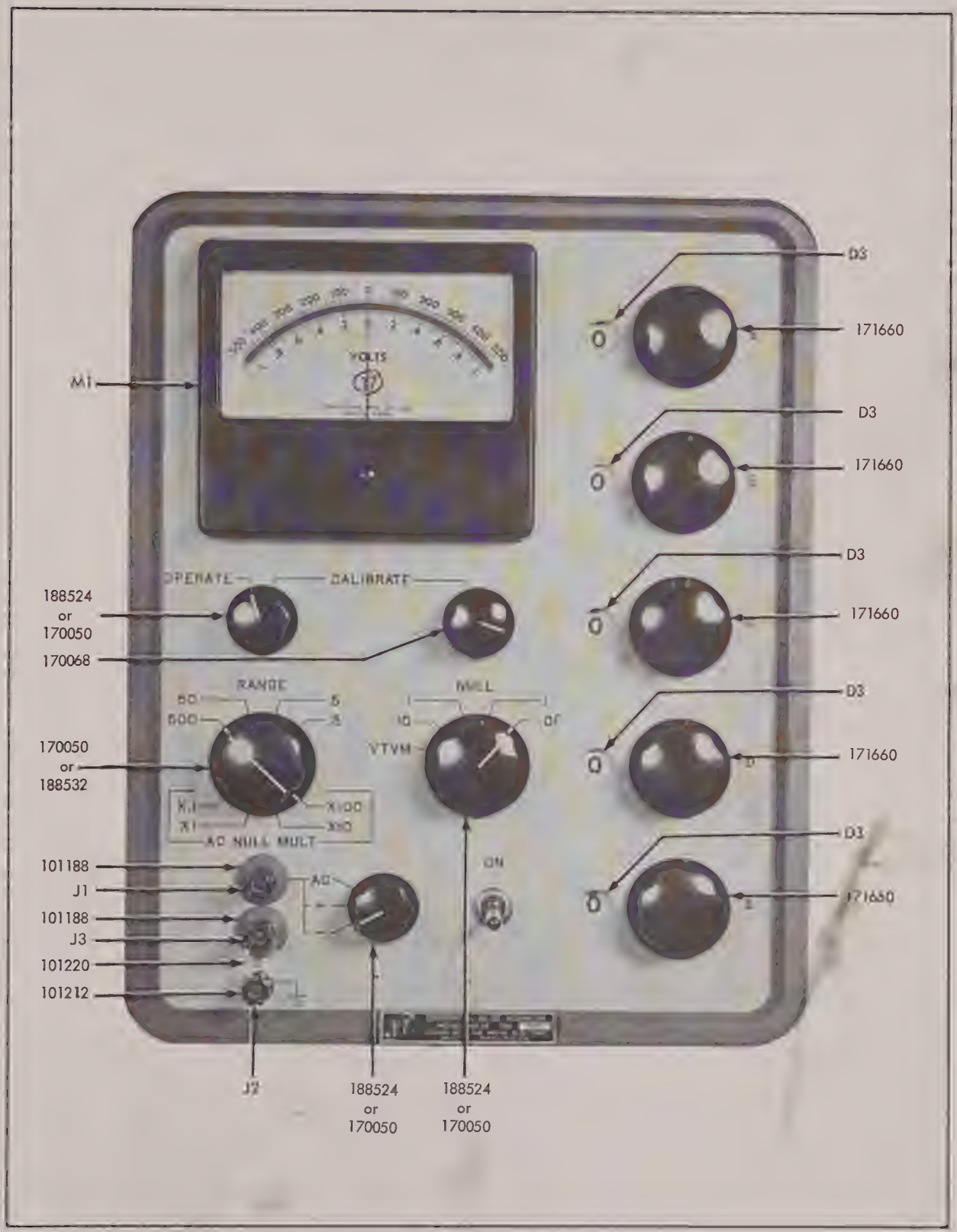



Figure 5-2. FRONT PANEL ASSEMBLY (sheet 1 of 2)

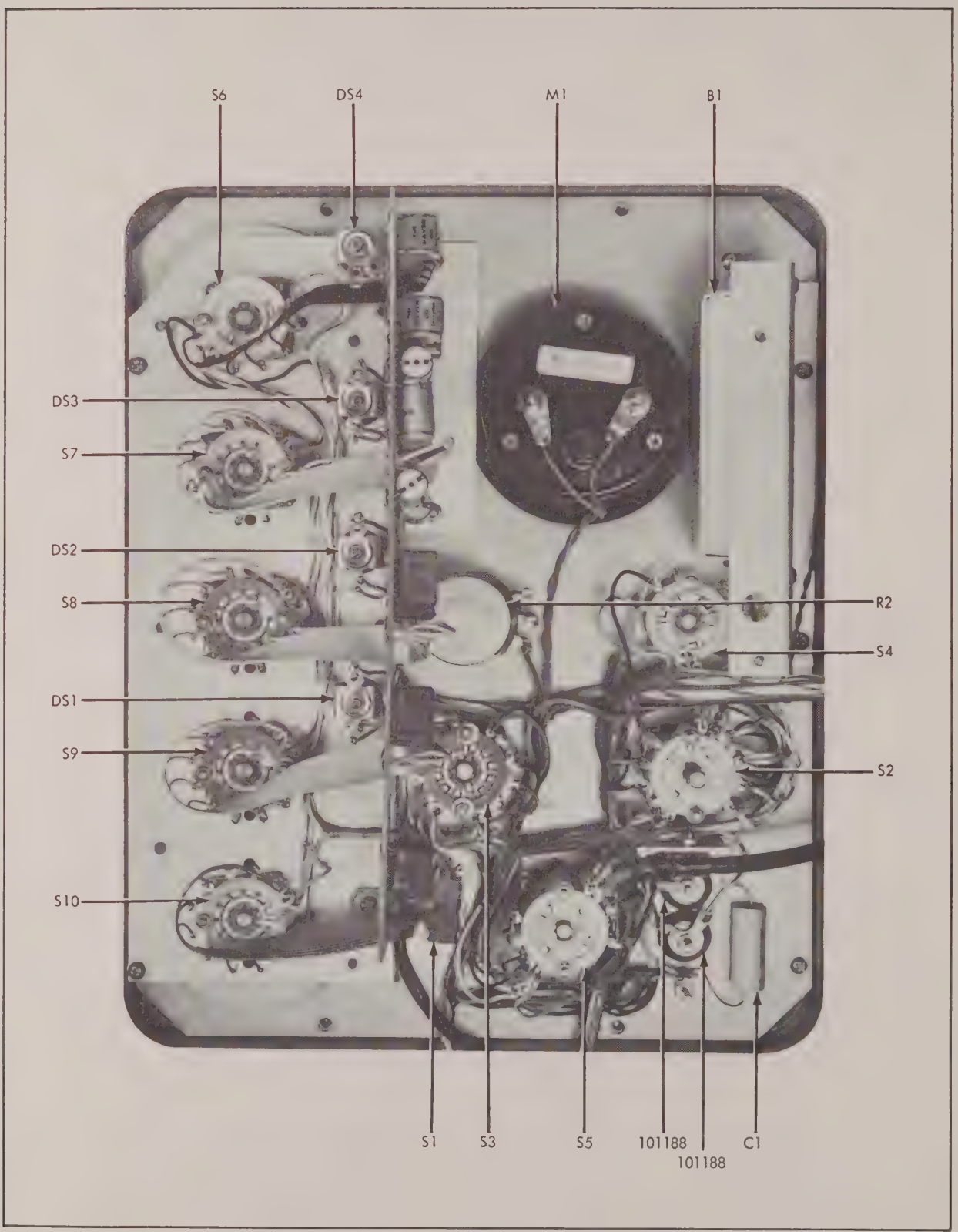



Figure 5-2. FRONT PANEL ASSEMBLY (sheet 2 of 2)

| REFERENCE DESIGNATION | DESCRIPTION | FLUKE STOCK NO. | USE CODE |
|---|---|---|---|
| | Reference Supply Board Assembly without tubes | *803B-449<br>*803BR-412<br>*125088 | E<br>F<br>L |
| C101, C102 | Capacitor, electrolytic, 20 uf -10/+100%, 500V | 105932 | |
| C103 | Capacitor, electrolytic, 4000 uf -10/+100%, 15V | 105163 | |
| C104 | Capacitor, paper, 0.1 uf ±20%, 400V | 105312 | |
| C105 | Capacitor, plastic, 0.033 uf ±20%, 600V | 105916 | |
| C106 | Capacitor, plastic, 0.1 uf ±20%, 600V | 105833 | |
| C107 | Capacitor, ceramic, 0.01 uf -20/+80%, 500V | 105668 | |
| CR101 thru CR103 | Diode, silicon, 0.750 Amp, 600 PIV<br>Diode, silicon, 0.750 Amp, 600 PIV | 112680<br>112383 | Y<br>Z |
| CR104, CR107 | Diode, silicon, 1 Amp, 50 PIV<br>Diode, silicon, 1 Amp, 100 PIV | 112409<br>116111 | AI<br>AJ |
| Q1 | Transistor, germanium, NPN, 2N214<br>Transistor, silicon, NPN, 2N3721 | 116137<br>117267 | O<br>P |
| Q2 | Transistor, germanium, PNP, 2N1372 | 116129 | |
| R101 | Resistor, composition, 1 Meg ±10%, 1/2W | 108134 | |
| R102 | Resistor, composition, 220K ±10%, 1/2W | 108217 | |
| R104 | Resistor, carbon film 5K ±1%, 1/2W<br>Resistor, carbon film, 5.44K ±1%, 1/2W | 107110<br>107235 | O<br>P |
| R105 | Resistor, carbon film, 135K ±1%, 1/2W<br>Resistor, carbon film, 125K ±1%, 1/2W | 107201<br>107433 | O<br>P |
| R106 | Resistor, composition, 8.2K ±10%, 1/2W | 109017 | |
| R107, R108 | Resistor, carbon film, 50Ω ±1%, 1/2W | 107037 | |
| R109, R110 | Resistor, composition, 270K ±10%, 1W | 109512 | |
| R111 | Resistor, composition, 22 Meg ±10%, 1/2W | 108233 | |
| R112 | Resistor, composition, 15 Meg ±10%, 1/2W | 108647 | |
| R113 | Resistor, composition, 10 Meg ±10%, 1/2W | 108142 | |
| R114 | Resistor, composition, 100K ±10%, 1W | 109397 | |
| R115 | Resistor, wirewound, 140K ±3%, 10W | 112417 | |
| R116 | Resistor, composition, 100K ±10%, 1/2W | 108126 | |
| R117 | Resistor, composition, 560K ±10%, 1W | 109678 | |
| R118 | Resistor, composition, 220K ±10%, 1/2W | 108217 | |
| R119 | Resistor, composition, 330Ω ±10%, 1/2W | 108589 | |
| R120 | Resistor, composition, 220K ±10%, 1W | 109652 | |
| R121 | Resistor, variable wirewound, 5K ±5%, 2W | 111609 | |
| R122 | Resistor, composition, 560K ±10%, 1W | 109678 | |
| R123 | Resistor, wirewound, 386K ±0.5%, 1W | 112482 | |
| R124 | Resistor, wirewound, 76K ±0.5%, 1/2W | 111948 | |

| REFERENCE DESIGNATION | DESCRIPTION | FLUKE STOCK NO. | USE CODE |
|---|---|---|---|
| R125 | Resistor, composition, 82K ±10%, 1/2W | 108498 | |
| V101 | Vacuum tube, pentode, EL84/6BQ5 | 116616 | |
| V102 | Vacuum tube, voltage reference, aged OG3 | *116749 | |
| V103 | Lamp, neon glow, NE2E<br>Lamp, neon glow, NE83 | 100347<br>170167 | AK<br>AL |
| V104, V105 | Vacuum tube, duo triode, 12AX7 | 115956 | |

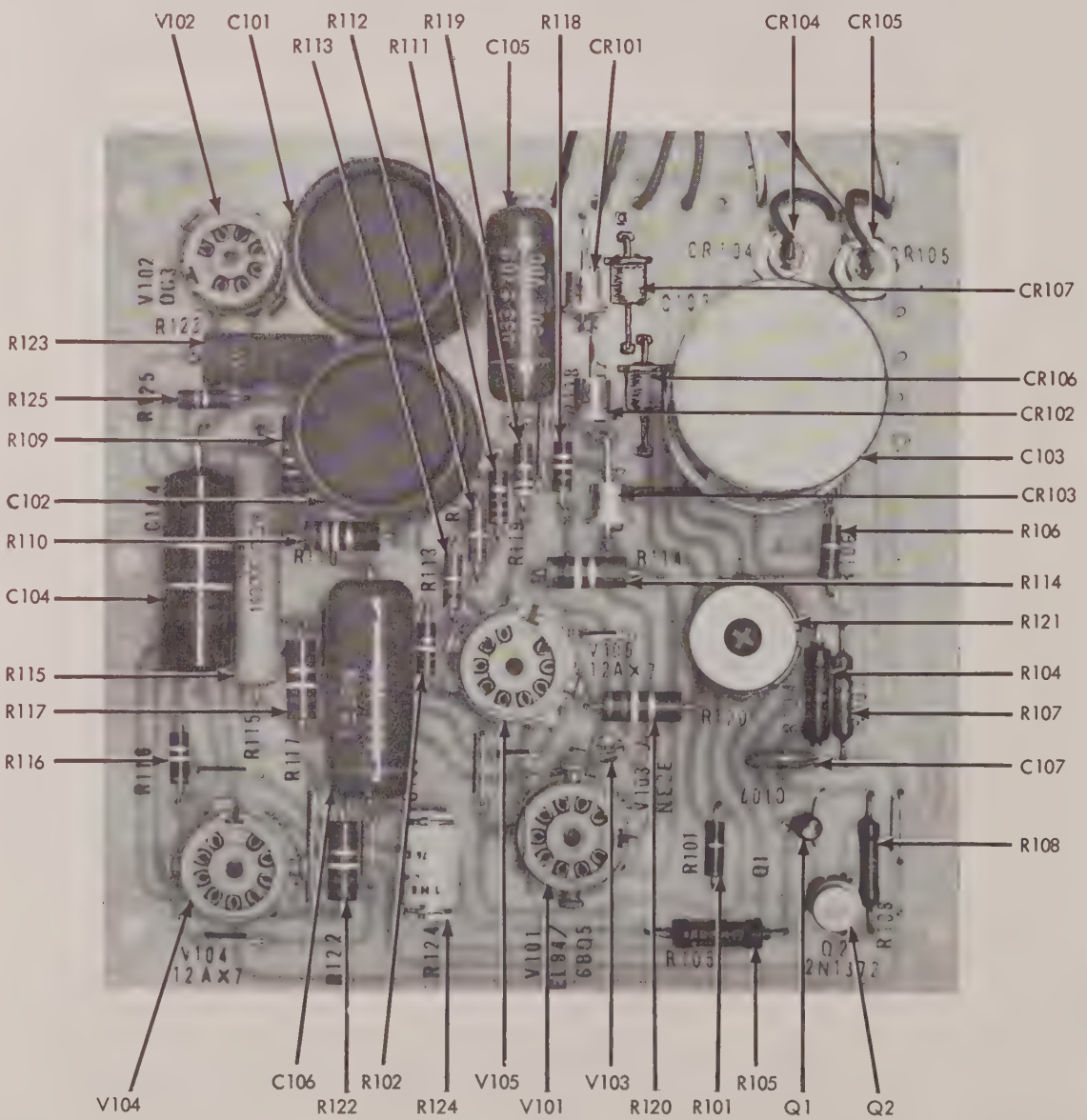



Figure 5-3. REFERENCE SUPPLY BOARD ASSEMBLY

| REFERENCE DESIGNATION | DESCRIPTION | FLUKE STOCK NO. | USE CODE |
|---|---|---|---|
| | Null Detector Board Assembly | *120501<br>*150029 | Q<br>R |
| C201, C202 | Capacitor, plastic, 0.1 uf ±20%, 200V<br>Capacitor, plastic, 0.1 uf ±20%, 200V | 106310<br>106435 | M<br>N |
| C203 | Capacitor, plastic, 0.047 uf ±20%, 100V | 106401 | |
| C204 | Capacitor, plastic, 0.47 uf ±20%, 200V | 106419 | |
| C205 | Capacitor, electrolytic, 40 uf -10/+100%, 6V | 105205 | |
| C206 | Capacitor, ceramic, 0.001 uf ±20%, 3000V | 105635 | |
| C207 | Capacitor, electrolytic, 10 uf -10/+100%, 150V | 106351 | |
| C208 | Capacitor, plastic, 0.1 uf ±20%, 200V<br>Capacitor, plastic, 0.1 uf ±20%, 200V | 106310<br>106435 | M<br>N |
| C209 | Capacitor, plastic, 0.47 uf ±20%, 200V | 106419 | |
| C210 | Capacitor, plastic, 0.1 uf ±20%, 200V<br>Capacitor, plastic, 0.1 uf ±20%, 200V | 106310<br>106435 | M<br>N |
| C211 | Capacitor, plastic, 1 uf ±20%, 200V<br>Capacitor, plastic, 0.18 uf ±10%, 200V | 106450<br>105874 | S<br>T |
| C212 | Capacitor, electrolytic, 200 uf -10/+100%, 6V | 105189 | |
| C213 | Capacitor, ceramic, 3.3 uuf ±15%, 1000V<br>Capacitor, ceramic, 7.5 uuf ±20%, 1000V | 105577<br>106849 | Q<br>R |
| C214A, C214B | Capacitor, dual electrolytic 20/20 uf -10/+50%, 450V | 106427 | |
| C215 | Capacitor, electrolytic, 15 uf -10/+150%, 6V | 105700 | |
| CR201 | Diode, silicon, 0.75 Amp, 600 PIV<br>Diode, silicon, 0.75 Amp, 600 PIV | 112680<br>112383 | Y<br>Z |
| CR202, CR203 | Diode, silicon, 1 Amp, 100 PIV | 116111 | |
| G1 | Chopper, electronic, 60 cycle, SPDT | 103051 | |
| R201 thru R203 | Resistor, composition, 1 Meg ±10%, 1/2W | 108134 | |
| R204 | Resistor, composition, 3.9 Meg ±10%, 1/2W | 108548 | |
| R205 | Resistor, composition, 2.7 Meg ±10%, 1/2W | 108266 | |
| R206 | Resistor, composition, 470K ±10%, 1/2W | 108290 | |
| R207 | Resistor, composition, 4.7K ±10%, 1/2W | 108381 | |
| R208 | Resistor, composition, 10K ±10%, 1/2W | 108118 | |
| R209, R210 | Resistor, composition, 1 Meg ±10%, 1/2W | 108134 | |
| R211 | Resistor, composition, 330K ±10%, 1/2W | 108274 | |
| R212 | Resistor, composition, 180K ±10%, 1/2W | 108431 | |
| R213 | Resistor, composition, 1K ±10%, 1/2W | 108563 | |
| R214 | Resistor, composition, 1 Meg ±10%, 1/2W | 108134 | |
| R215 | Resistor, composition, 27K ±10%, 1/2W | 108878 | |

| REFERENCE DESIGNATION | DESCRIPTION | FLUKE STOCK NO. | USE CODE |
|---|---|---|---|
| R216 | Resistor, composition, 560Ω ±10%, 1/2W | ** 108316 | U, AO |
| | Resistor, composition, 1K ±10%, 1/2W | 108563 | V |
| | Resistor, composition, 330Ω ±10%, 1/2W | ** 108589 | AO |
| R217 | Resistor, composition, 100Ω ±10%, 1/2W | 108100 | |
| R218 | Resistor, deposited carbon, 93.1Ω ±1%, 1/2W | 107755 | U |
| | Resistor, metal film, 90.9Ω ±1%, 1/2W | 151084 | V |
| R219 | Resistor, variable wirewound, 10Ω ±20%, 1-1/4W | 112672 | |
| R220 | Resistor, composition, 3.3k ±10%, 1/2W | 108373 | |
| | Resistor, composition, 2.2K ±10%, 1/2W | 108605 | AO |
| R221 | Resistor, composition, 3.3K ±10%, 1/2W | 108373 | Q, AO |
| | Resistor, composition, 2.2K ±10%, 1/2W | 108605 | R |
| R222, R223 | Resistor, composition, 47K ±10%, 2W | 110015 | |
| R224 | Resistor, composition, 2.7Ω ±10%, 1/2W | 108845 | |
| R225, R226 | Resistor, composition, 1K ±10%, 1/2W | 108563 | |
| R227 | Resistor, variable, wirewound, 5K ±20%, 1-1/4W | 111609 | |
| R228, R229 | Resistor, composition, 2.7K ±10%, 2W | 110148 | |
| R230 | Resistor, composition, 1K ±10%, 1/2W | 108563 | |
| V201 | Lamp, neon glow, type NE2E, 1/10W | 100347 | |
| V202 | Vacuum tube, pentode, EF86/6267 | 116715 | |
| V203 | Vacuum tube, triode-pentode, 6AW8A | 116434 | |
| V204 | Vacuum tube, voltage reference, OA2 | 115873 | |

** Factory selected may be either 560 or 330 ohms

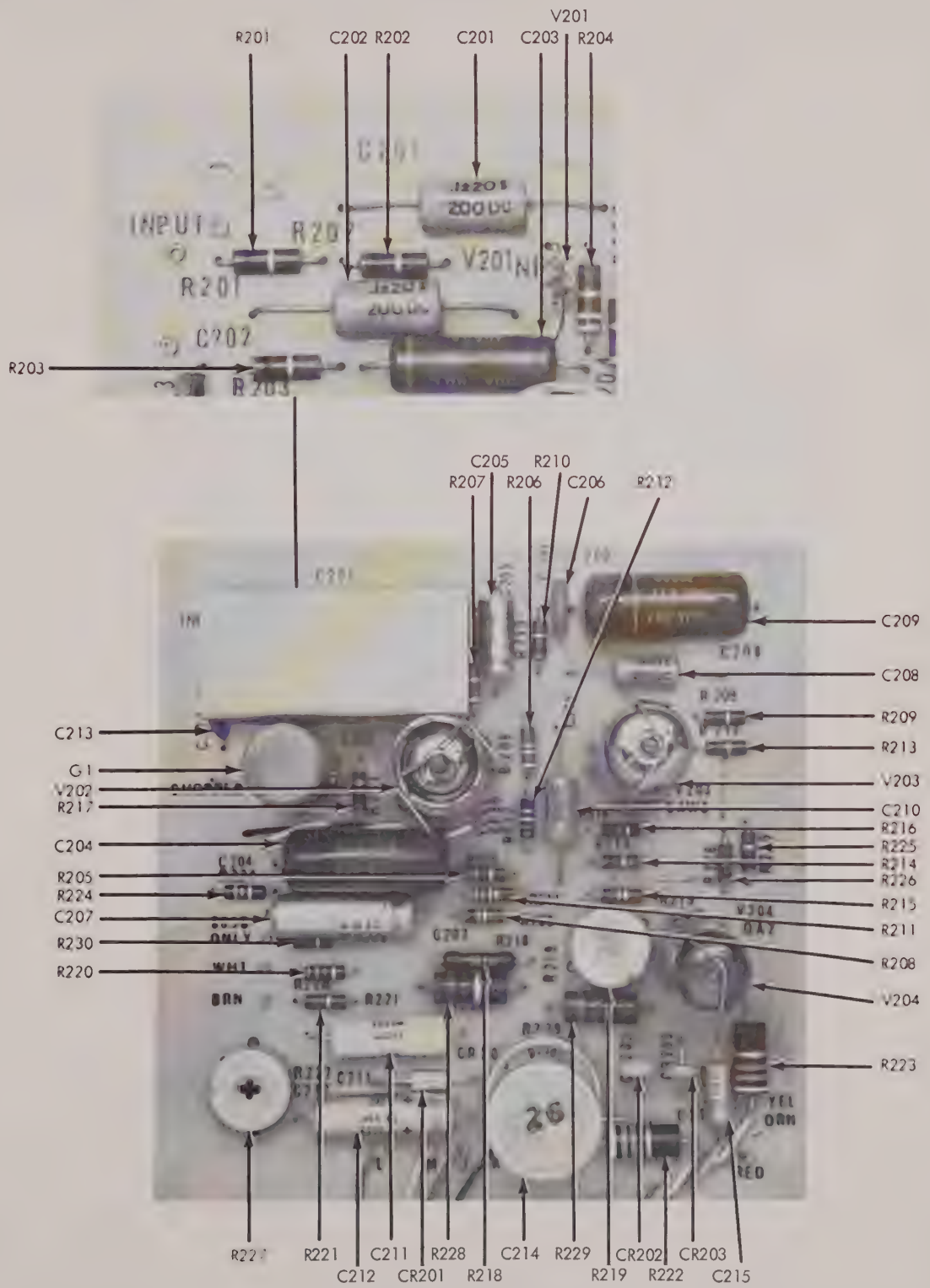



Figure 5-4. NULL DETECTOR BOARD ASSEMBLY

| REFERENCE DESIGNATION | DESCRIPTION | FLUKE STOCK NO. | USE CODE |
|---|---|---|---|
| | Range Resistor Board Assembly | | |
| | Model 803B | *120477 | AC |
| | | *159541 | AD |
| | Model 803BR | *120923 | AC |
| | | *159533 | AD |
| | Model 803B/AG | *120972 | AC |
| | | *153478 | AD |
| | Model 803BR/AG | *120485 | AC |
| | | *153486 | AD |
| C301 | Capacitor, plastic, 1 uf ±20%, 600V | 105924 | |
| C302 | Capacitor, plastic, 2 uf ±20%, 200V | 106443 | |
| CR301 | Zener diode (803B/AG and 803BR/AG. If replacement is required, CR301, R3, and R319 must be replaced with one of the Zener-resistor sets listed below. An adhesive label included must be attached to Range Resistor Board to give future ordering data for R3 and R319.) | | |
| | Zener-resistor set 801B/G-410 (Replace with 158824) | | AC |
| | Zener-resistor set 801B/G-407 or 801B/G-409 (These two sets are completely interchangeable.) | 158824 | AD |
| R301 thru R304 | Resistors, carbon film, matched set of four, 10 Meg | 200626 | |
| R305 | Resistor, carbon film, 9 Meg ±1%, 1W | 107557 | |
| R306 | Resistor, carbon film, 900K ±1%, 1/2W | 107391 | |
| R307 | Resistor, carbon film, 90K ±1%, 1/2W | 107292 | |
| R308 | Resistor, carbon film, 9K ±1%, 1/2W | 107250 | |
| R309 | Resistor, carbon film, 900 ±1%, 1/2W | 107771 | |
| R310 | Resistor, carbon film, 100 ±1%, 1/2W | 107730 | |
| R311 thru R315 | Resistor, composition, 22 Meg ±10%, 1/2W | 108233 | |
| R316, R317 | Resistor, wirewound, 125K ±0.1%, 1W | 112102 | AC |
| | Resistor, wirewound, 112.375K ±0.05%, 1W | 112110 | AD |
| R318 | Resistor, variable wirewound, 1K ±20%, 1-1/4W | 111575 | AE |
| | Resistor, variable wirewound, 3K ±20%, 1-1/4W | 112458 | AF |
| | Resistor, variable wirewound, 1K ±20%, 1-1/4W | 113266 | AD |
| R319 | Resistor, wirewound, 511.7Ω ±0.1%, 1/2W | 112706 | AC |
| | Resistor, wirewound, 459.8Ω ±0.025%, 1/8W | 132001 | AD |
| | Resistor, wirewound (803B/AG and 803BR/AG. Optimum value is selected at factory to match Zener diode. When ordering, include date and serial number listed on Range Resistor Printed Circuit Board decal.) | | |
| R320, R321 | Resistor, wirewound, 112.375K ±0.05%, 1W | 112110 | |
| R322 | Resistor, composition, 27K ±10%, 1W | 109504 | |
| R323 | Resistor, variable wirewound, 500Ω ±10%, 1-1/4W | 112433 | AC |
| | Resistor, variable wirewound, 500Ω ±10%, 1-1/4W | 113258 | AD |
| R324 | Resistor, wirewound, 28.571K ±0.05%, 1/2W | 112060 | |
| R325 | Resistor, wirewound, 22.5K ±0.1%, 1/2W | 112045 | |
| R326 | Resistor, variable wirewound, 500Ω ±10%, 1-1/4W | 112433 | AC |
| | Resistor, variable wirewound, 500Ω ±10%, 1-1/4W | 113258 | AD |
| R327 | Resistor, wirewound, 2531.7Ω ±0.05%, 1/2W | 111906 | |

| REFERENCE DESIGNATION | DESCRIPTION | FLUKE STOCK NO. | USE CODE |
|---|---|---|---|
| R328 | Resistor, wirewound, 24.75K ±0.1%, 1/2W | 112052 | |
| R329 | Resistor, variable wirewound, 500Ω ±10%, 1-1/4W | 112433 | AC |
| | Resistor, variable wirewound, 500Ω ±10%, 1-1/4W | 113258 | AD |
| R330 | Resistor, wirewound, 250.31Ω ±0.05%, 1/2W | 112011 | |
| R331 | Resistor, composition, 270Ω ±10%, 1/2W | 108241 | |

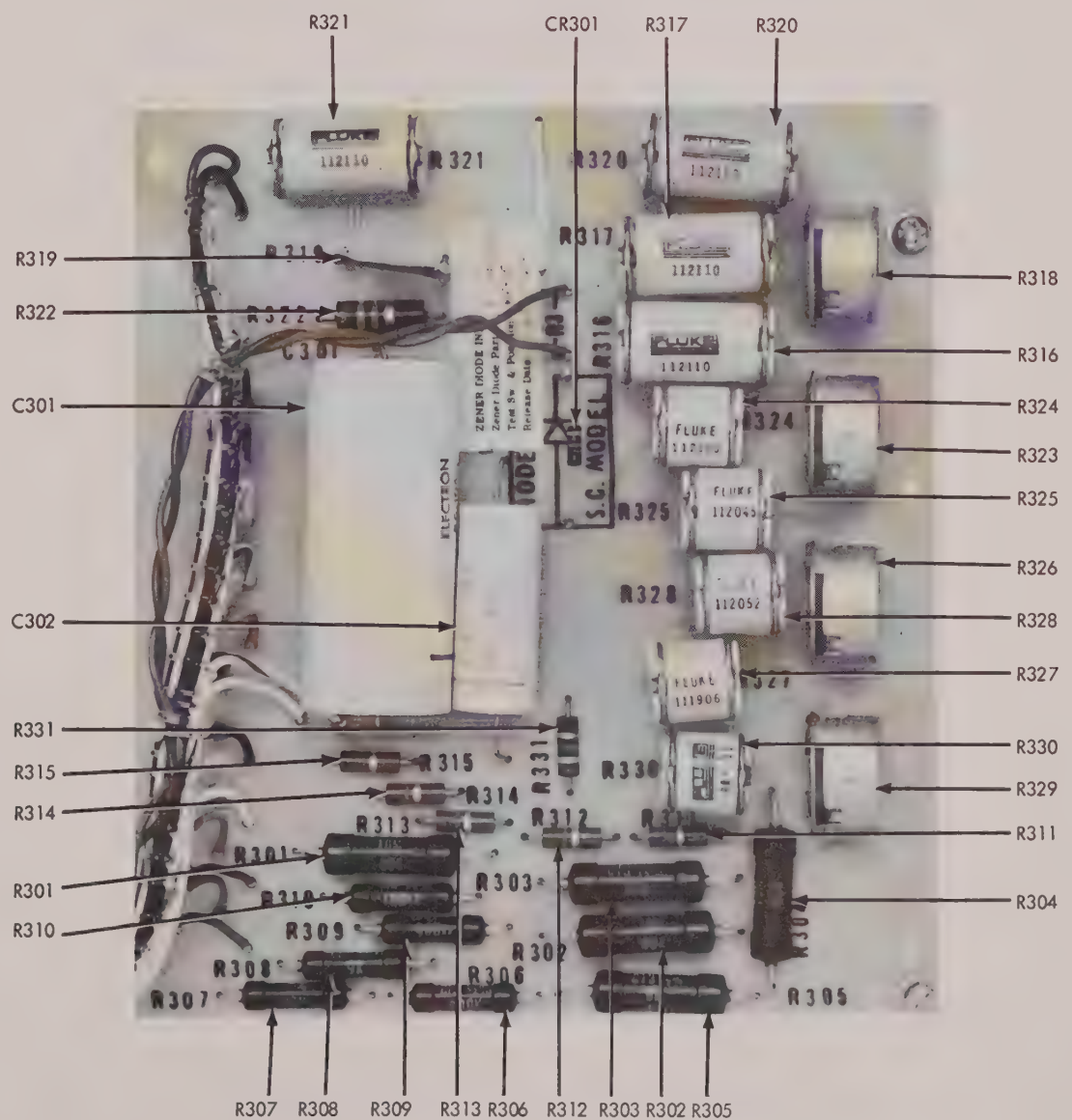



Figure 5-5. RANGE RESISTOR BOARD ASSEMBLY

| REFERENCE DESIGNATION | DESCRIPTION | FLUKE STOCK NO. | USE CODE |
|---|---|---|---|
| | Kelvin-Varley Resistor Board Assembly | *134775 | |
| R401 thru R406** | Resistor, wirewound, 40K ±0.02%, 1/2W | *146530 | |
| R407 thru R417** | Resistor, wirewound, 8K ±0.005%, 1/2W | *131946 | |
| R418 thru R428** | Resistor, wirewound, 1.6K ±0.01%, 1/8W | *131953 | |
| R429 thru R439 | Resistor, wirewound, 320Ω ±0.02%, 1/8W | *146159 | |
| R440 thru R449 | Resistor, wirewound, 64Ω ±0.1%, 1/8W | *146167 | |

**These resistors are factory matched for each instrument. When ordering, specify instrument model and serial number and all information stamped on resistor.

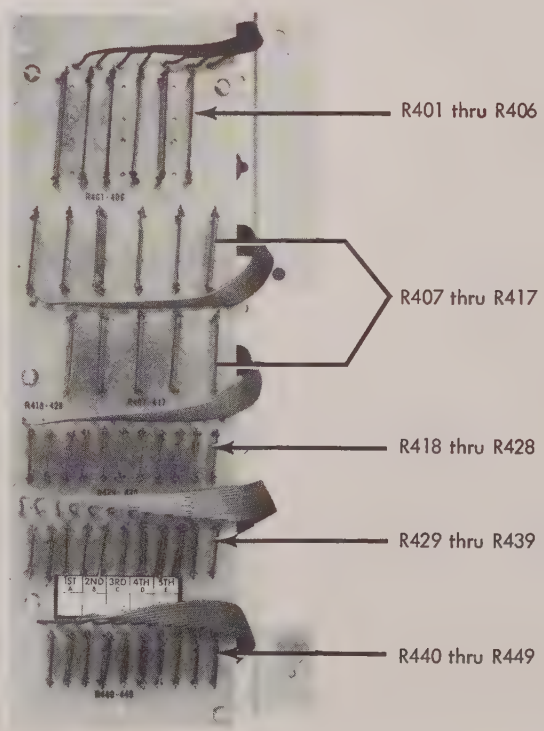



Figure 5-6. KELVIN-VARLEY RESISTOR BOARD ASSEMBLY

| REFERENCE DESIGNATION | DESCRIPTIONS | FLUKE STOCK NO. | USE CODE |
|---|---|---|---|
| | Converter/AC Range Switch Assembly | *120527 | |
| CR501, CR502 | Diode, silicon, 60 ma, 40 PIV | 178665 | |
| | Converter Assembly | *120535 | |
| C505AB | Capacitor, electrolytic, 10-10 uf -10/+50%, 500V | 105130 | |
| C506 | Capacitor, ceramic, 0.005 uf ±20%, 500V | 105650 | |
| C507 | Capacitor, ceramic, 300 uf ±10%, 500V | 105734 | |
| C508 | Capacitor, plastic, 0.47 uf ±20%, 200V | 106419 | |
| C509 | Capacitor, plastic, 0.0068 uf ±20%, 400V | 106591 | |
| C510 | Capacitor, ceramic, 0.001 uf ±20%, 3000V | 105635 | |
| C511 | Capacitor, plastic, 0.47 uf ±20%, 400V | 105759 | |
| C512 | Capacitor, paper, 0.1 uf ±20%, 400V | 105312 | |
| C513 | Capacitor, electrolytic, 20 uf -10/+100%, 50V | 106229 | |
| C514 | Capacitor, ceramic, 2.2 uf -0%, 3V | 106393 | |
| C515 | Capacitor, plastic, 2 uf ±20%, 200V | 106443 | |
| C516 | Capacitor, paper, 1 uf ±20%, 600V | 105924 | |
| C517 | Capacitor, plastic, 5 uf ±20%, 200V<br>Capacitor, plastic, 5 uf ±5%, 200V | 106468<br>106997 | W<br>X |
| C518 | Capacitor, plastic, 2 uf ±20%, 200V | 106443 | |
| C522 | Capacitor, electrolytic, 500 uf -10/+100%, 3V | 106328 | |
| CR503 | Diode, silicon, 1 Amp, 100 PIV | 116111 | |
| R506, R507 | Resistor, metal film, 68K ±5%, 2W | 111112 | |
| R508 | Resistor, metal film, 56K ±5%, 2W | 111104 | |
| R509 | Resistor, metal film, 100K ±5%, 5W | 111195 | |
| R510, R511 | Resistor, composition, 3.3K ±10%, 1/2W | 108373 | |
| R512 | Resistor, composition, 220Ω ±10%, 1/2W | 108191 | |
| R513 | Resistor, composition, 270Ω ±10%, 1/2W | 108241 | |
| R514 | Resistor, composition, 1.8 Meg ±10%, 1/2W | 108720 | |
| R515 | Resistor, composition, 2.2 Meg ±10%, 1/2W | 108225 | |
| R516 | Resistor, composition, 15 Meg ±10%, 1/2W | 108647 | |
| R517 | Resistor, composition, 18 Meg ±10%, 1/2W | 108985 | |
| R518 | Resistor, composition, 1.8 Meg ±10%, 1/2W | 108720 | |

| REFERENCE DESIGNATION | DESCRIPTION | FLUKE STOCK NO. | USE CODE |
|---|---|---|---|
| R519 | Resistor, composition, 47Ω ±10%, 1/2W | 108688 | |
| R520 | Resistor, metal film, 120K ±5%, 2W | 111120 | |
| R521 | Resistor, composition, 180Ω ±10%, 1/2W | 108571 | |
| R522 | Resistor, composition, 10K ±10%, 1/2W | 108118 | |
| R523 | Resistor, composition, 390Ω ±10%, 1/2W | 108365 | |
| R524 | Resistor, composition, 330K ±10%, 1/2W | 108274 | |
| R525 | Resistor, composition, 470K ±10%, 1/2W | 108290 | |
| R526 | Resistor, composition, 220K ±10%, 1/2W | 108217 | |
| R527 | Resistor, composition, 47Ω ±10%, 1/2W | 108688 | |
| R528 | Resistor, metal film, 150K ±5%, 2W | 111138 | |
| R529 | Resistor, composition, 100K ±10%, 1W | 109397 | |
| R530 | Resistor, metal film, 47K ±5%, 5W | 111187 | |
| R531 | Resistor, composition, 220Ω ±10%, 1/2W | 108191 | |
| R532 | Resistor, composition, 470K ±10%, 1/2W | 108290 | |
| R536 | Resistor, variable wirewound, 500Ω ±10%, 1-1/4W | 112433 | |
| R537 | Resistor, deposited carbon, 100K ±1%, 1/2W | 107185 | |
| R538 | Resistor, wirewound, 21.6K ±0.1%, 1/2W (This is an average value, Optimum value is selected at factory.) | PR681 | A |
| | Resistor, wirewound, 21.28K ±0.1%, 1/2W | 113217 | B |
| R539 | Resistor, wirewound, 490Ω ±0.1%, 1/2W | 112805 | |
| V501 | Vacuum tube, pentode, 6EJ7 | 116699 | |
| V502 | Vacuum tube, triode-pentode, 6AW8A | 116434 | |
| | AC Range Switch Assembly | *120543 | |
| | AC-Range-Switch Gain Adjust Assembly | | |
| R503 | Resistor, variable wirewound, 5K ±20%, 1-1/4W | 111609 | A |
| R503 | Resistor, variable wirewound, 6K ±5%, 1-1/4W | 113209 | B |
| R534 | Resistor, variable wirewound, 300Ω ±20%, 1-1/4W | 112870 | |
| | AC-Range-Switch Attenuator Assembly | | |
| C501 | Capacitor, variable, air, 0.8 to 4.5 uuf, 500V | 105023 | |
| C502 | Capacitor, ceramic, 20 uuf ±2%, 600V | 105619 | |
| C503 | Capacitor, plastic, 0.18 uf ±10%, 600V | 106740 | AA |
| | Capacitor, plastic, 0.12 uf ±5%, 600V | 107003 | AB |

| REFERENCE DESIGNATION | DESCRIPTION | FLUKE STOCK NO. | USE CODE |
|---|---|---|---|
| C523 | Capacitor, variable, air, 0.8 to 4.5 uuf, 500V | 105023 | |
| C524 | Capacitor, ceramic, 300 uuf ±5%, 600V | 105601 | |
| C525 | Capacitor, ceramic, 82 uuf ±5%, 600V | 105940 | |
| R501 | Resistor, metal film, 1 Meg ±1%, 1/2W | 111146 | |
| R502 | Resistor, metal film, 122K ±1%, 1/2W | 111260 | |
| R533 | Resistor, metal film, 500K ±1%, 1/2W | 111153 | |
| R535 | Resistor, wirewound, 10.05K ±0.1%, 1/2W | 112813 | |
| R543 | Resistor, metal film, 500K ±1%, 1/2W | 111153 | |
| R544 | Resistor, composition, 390K ±10%, 1/2W | 108993 | |
| | AC-Range-Switch Gain Network Assembly | | |
| C504, C519 | Capacitor, variable, air, 0.8 to 4.5 uuf, 500V | 105023 | |
| C520 | Capacitor, ceramic, 3.3 uuf ±20%, 600V | 106583 | |
| C521 | Capacitor, ceramic, 82 uuf ±2%, 600V | 105940 | |
| R504 | Resistor, metal film, 1 Meg ±0.5%, 1/2W | 111252 | |
| R505 | Resistor, composition, 47Ω ±10%, 1/2W | 108688 | |
| R540 | Resistor, metal film, 500K ±0.5%, 1/2W | 111245 | |
| R541 | Resistor, variable wirewound, 1K ±10%, 1/4W<br>Resistor, variable wirewound, 2K ±10%, 1/4W | 112698<br>113191 | A<br>B |
| R542 | Resistor, metal film, 48.75K ±1%, 1/2W | 111443 | |
| | AC-Range-Switch Switch Assembly | | |
| S2 | Switch, range, AC section | *120683 | |

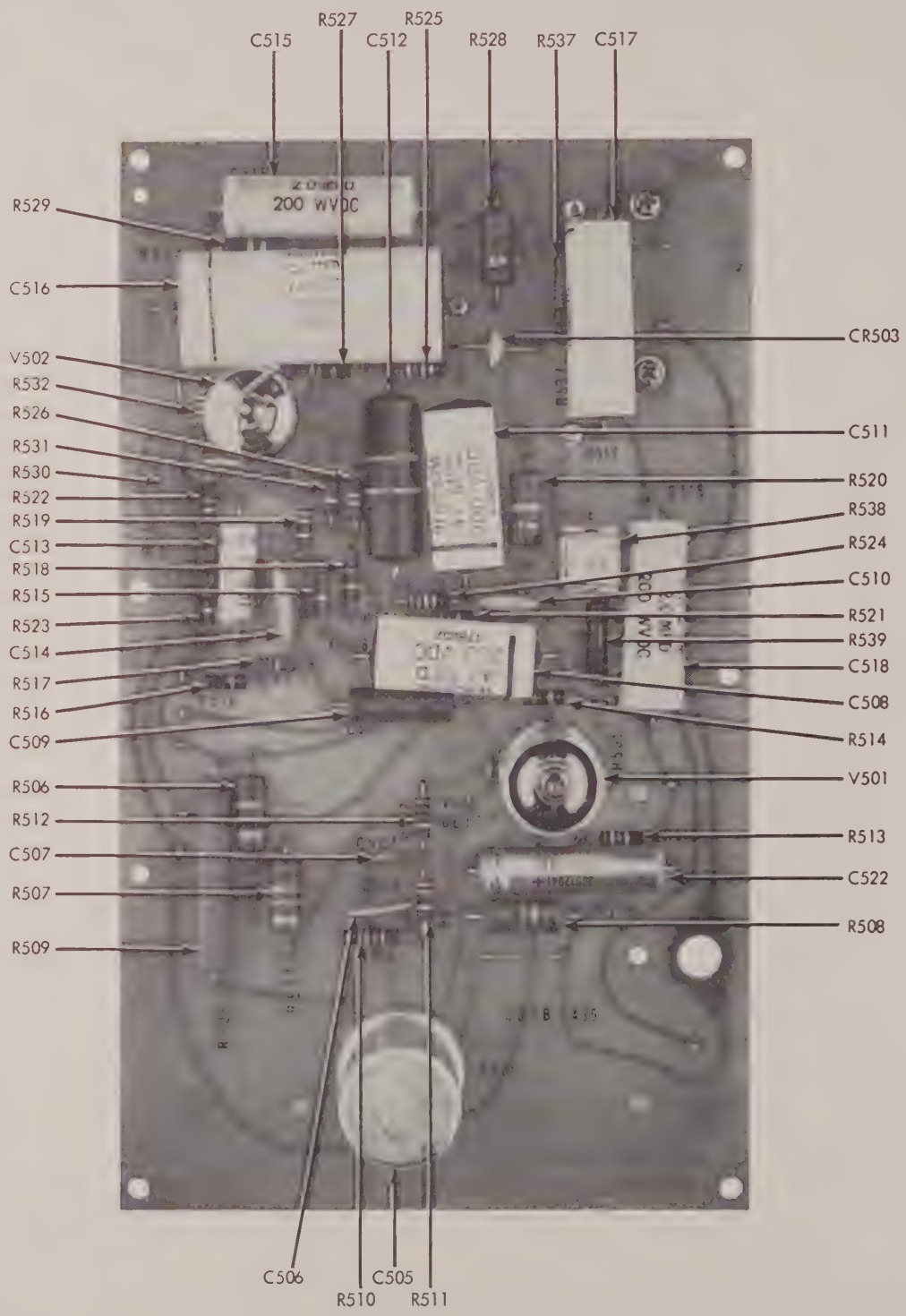



Figure 5-7. CONVERTER/AC RANGE SWITCH ASSEMBLY (sheet 1 of 2)

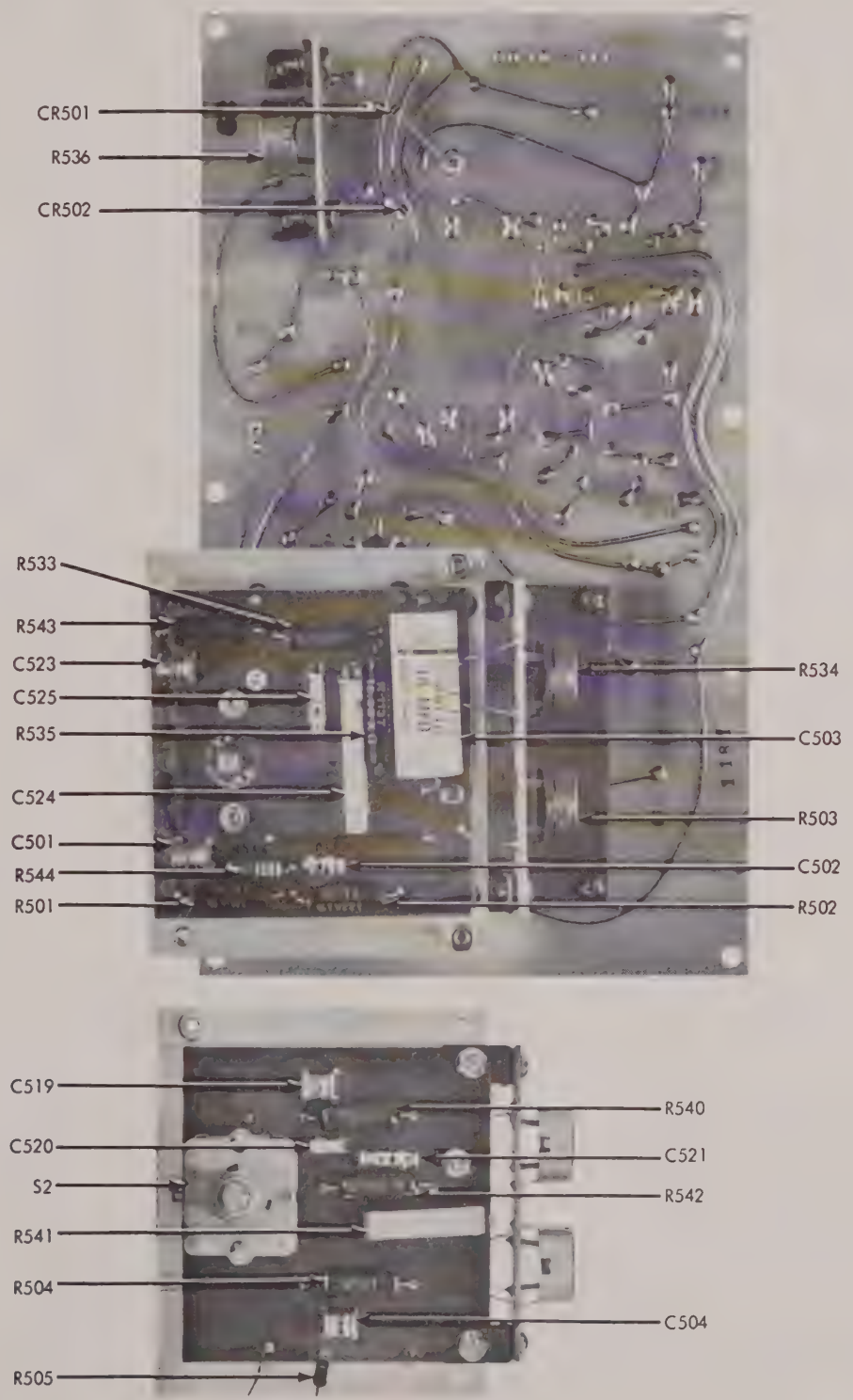



Figure 5-7. CONVERTER/AC RANGE SWITCH ASSEMBLY (sheet 2 of 2)

## USE CODE EFFECTIVITY

The following list of use codes is intended to allow the customer to determine the effectivity of all replaceable parts. All parts with no code are used on all instruments with serial numbers above 123. New codes will be added as necessary on forthcoming instruments.

| USE CODE | EFFECTIVITY |
|---|---|
| No Code | Model 803B serial number 123 and on<br>Model 803BR serial number 123 and on<br>Model 803B/AG serial number 123 and on<br>Model 803BR/AG serial number 123 and on |
| A | Model 803B serial number 123 thru 731<br>Model 803BR serial number 123 thru 306<br>Model 803B/AG serial number 123 thru 731<br>Model 803BR/AG serial number 123 thru 306 |
| B | Model 803B serial number 732 and on<br>Model 803BR serial number 307 and on<br>Model 803B/AG serial number 732 and on<br>Model 803BR/AG serial number 307 and on |
| C | Model 803B serial number 123 thru 1386<br>Model 803BR serial number 123 thru 431<br>Model 803B/AG serial number 123 thru 1386<br>Model 803BR/AG serial number 123 thru 431 |
| D | Model 803B serial number 1387 thru 2616<br>Model 803BR serial number 432 thru 851<br>Model 803B/AG serial number 1387 thru 2616<br>Model 803BR/AG serial number 432 thru 851 |
| E | Model 803B serial number 123 thru 1771<br>Model 803BR serial number 432 thru 531<br>Model 803B/AG serial number 123 thru 1771<br>Model 803BR/AG serial number 432 thru 531 |
| F | Model 803BR serial number 123 thru 431<br>Model 803BR/AG serial number 123 thru 431 |
| G | Model 803B serial number 123 thru 1046<br>Model 803BR serial number 123 thru 406<br>Model 803B/AG serial number 123 thru 1046<br>Model 803BR/AG serial number 123 thru 406 |
| H | Model 803B serial number 1047 and on<br>Model 803BR serial number 407 and on<br>Model 803B/AG serial number 1047 and on<br>Model 803BR/AG serial number 407 and on |
| I | Model 803B serial number 123 thru 1386<br>Model 803BR serial number 123 thru 431<br>Model 803B/AG serial number 123 thru 1386<br>Model 803BR/AG serial number 123 thru 431 |
| J | Model 803B serial number 1387 and on<br>Model 803BR serial number 432 and on<br>Model 803B/AG serial number 1387 and on<br>Model 803BR/AG serial number 432 and on |
| K | Model 803B serial number 1563 and on<br>Model 803BR serial number 532 and on<br>Model 803B/AG serial number 1563 and on<br>Model 803BR/AG serial number 532 and on |
| L | Model 803B serial number 1772 and on<br>Model 803BR serial number 532 and on<br>Model 803B/AG serial number 1772 and on<br>Model 803BR/AG serial number 532 and on |
| M | Model 803B serial number 123 thru 2269<br>Model 803BR serial number 123 thru 666<br>Model 803B/AG serial number 123 thru 2269<br>Model 803BR/AG serial number 123 thru 666 |
| N | Model 803B serial number 2270 and on<br>Model 803BR serial number 667 and on<br>Model 803B/AG serial number 2270 and on<br>Model 803BR/AG serial number 667 and on |
| O | Model 803B serial number 123 thru 2530<br>Model 803BR serial number 123 thru 776<br>Model 803B/AG serial number 123 thru 2530<br>Model 803BR/AG serial number 123 thru 776 |
| P | Model 803B serial number 2531 and on<br>Model 803BR serial number 777 and on<br>Model 803B/AG serial number 2531 and on<br>Model 803BR/AG serial number 777 and on |
| Q | Model 803B serial number 123 thru 2616<br>Model 803BR serial number 123 thru 851<br>Model 803B/AG serial number 123 thru 2616<br>Model 803BR/AG serial number 123 thru 851 |
| R | Model 803B serial number 2617 and on<br>Model 803BR serial number 852 and on<br>Model 803B/AG serial number 2617 and on<br>Model 803BR/AG serial number 852 and on |
| S | Model 803B serial number 123 thru 2616 and 3026 and on<br>Model 803BR serial number 123 thru 851 and 882 and on<br>Model 803B/AG serial number 123 thru 2616 and 3026 and on<br>Model 803BR/AG serial number 123 thru 851 and 882 and on |
| T | Model 803B serial number 2617 thru 3025<br>Model 803BR serial number 852 thru 881<br>Model 803B/AG serial number 2617 thru 3025<br>Model 803BR/AG serial number 852 thru 881 |
| U | Model 803B serial number 123 thru 3025<br>Model 803BR serial number 123 thru 881<br>Model 803B/AG serial number 123 thru 3025<br>Model 803BR/AG serial number 123 thru 881 |
| V | Model 803B serial number 3026 and on<br>Model 803BR serial number 882 and on<br>Model 803B/AG serial number 3026 and on<br>Model 803BR/AG serial number 882 and on |
| W | Model 803B serial number 123 thru 2301<br>Model 803BR serial number 123 thru 666<br>Model 803B/AG serial number 123 thru 2301<br>Model 803BR/AG serial number 123 thru 666 |
| X | Model 803B serial number 2302 and on<br>Model 803BR serial number 667 and on<br>Model 803B/AG serial number 2302 and on<br>Model 803BR/AG serial number 667 and on |

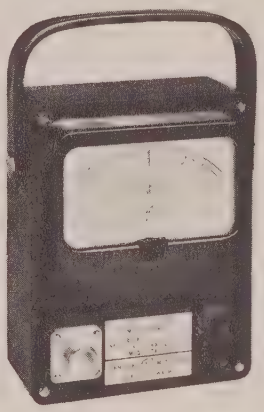
| USE CODE | EFFECTIVITY |
|---|---|
| Y | Model 803B serial number 123 thru 3016<br>Model 803BR serial number 123 thru 881<br>Model 803B/AG serial number 123 thru 3016<br>Model 803BR/AG serial number 123 thru 881 |
| Z | Model 803B serial number 3017 and on<br>Model 803BR serial number 882 and on<br>Model 803B/AG serial number 3017 and on<br>Model 803BR/AG serial number 882 and on |
| AA | Model 803B serial number 123 thru 3566<br>Model 803BR serial number 123 thru 976<br>Model 803B/AG serial number 123 thru 3566<br>Model 803BR/AG serial number 123 thru 976 |
| AB | Model 803B serial number 3567 and on<br>Model 803BR serial number 977 and on<br>Model 803B/AG serial number 3567 and on<br>Model 803BR/AG serial number 977 and on |
| AC | Model 803B serial number 123 thru 3604<br>Model 803BR serial number 123 thru 1022<br>Model 803B/AG serial number 123 thru 3077<br>Model 803BR/AG serial number 123 thru 986 |
| AD | Model 803B serial number 3605 and on<br>Model 803BR serial number 1023 and on<br>Model 803B/AG serial number 3078 and on<br>Model 803BR/AG serial number 987 and on |
| AE | Model 803B serial number 123 thru 3604<br>Model 803BR serial number 123 thru 1022 |
| AF | Model 803B/AG serial number 123 thru 3077<br>Model 803BR/AG serial number 123 thru 986 |
| AG | Model 803B serial number 2617 thru 3944<br>Model 803BR serial number 852 thru 1091<br>Model 803B/AG serial number 2617 thru 3944<br>Model 803BR/AG serial number 852 thru 1091 |
| AH | Model 803B serial number 3945 and on<br>Model 803BR serial number 1092 and on<br>Model 803B/AG serial number 3945 and on<br>Model 803BR/AG serial number 1092 and on |
| AI | Model 803B serial number 123 thru 3995<br>Model 803BR serial number 123 thru 1116<br>Model 803B/AG serial number 123 thru 3995<br>Model 803BR/AG serial number 123 thru 1116 |
| AJ | Model 803B serial number 3996 and on<br>Model 803BR serial number 1117 and on<br>Model 803B/AG serial number 3996 and on<br>Model 803BR/AG serial number 1117 and on |
| AK | Model 803B serial number 123 thru 4115<br>Model 803BR serial number 123 thru 1141<br>Model 803B/AG serial number 123 thru 4115<br>Model 803BR/AG serial number 123 thru 1141 |
| AL | Model 803B serial number 4116 and on<br>Model 803BR serial number 1142 and on<br>Model 803B/AG serial number 4116 and on<br>Model 803BR/AG serial number 1142 and on |
| AM | Model 803B serial number 123 thru 4446<br>Model 803BR serial number 123 thru 1166<br>Model 803B/AG serial number 123 thru 4446<br>Model 803BR/AG serial number 123 thru 1166 |
| AN | Model 803B serial number 4447 and on<br>Model 803BR serial number 1167 and on<br>Model 803B/AG serial number 4447 and on<br>Model 803BR/AG serial number 1167 and on |
| AO | Model 803B serial number 5693 and on<br>Model 803BR serial number 1437 and on |
| AP | Model 803B serial number 5693 and on<br>Model 803B serial number 1115 and on |
| AQ | Model 803B serial number 5803 and on<br>Model 803BR serial number 1511 and on<br>Model 803B/AG serial number 5693 and on<br>Model 803BR/AG serial number 1115 and on |

# SECTION VI

# ACCESSORIES

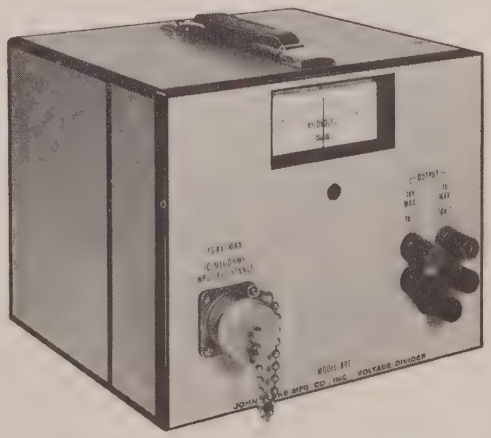
## 6-1. PRECISION VOLTAGE DIVIDERS

6-2. The FLUKE 80A, 80D, and 80E Voltage Dividers provide the FLUKE 800 Series Differential Voltmeters with the ability to make high accuracy measurements up to 30,000 volts DC. All models contain a zero center panel meter which allows the polarity and approximate magnitude of the unknown high voltage to be easily observed. At maximum input, all units draw but 1 ma of current from the unknown. The extreme accuracy and excellent long term stability of these dividers are obtained by using properly aged precision wirewound resistors which have a very low temperature coefficient. To further ensure high accuracy and long term stability at very high voltages, the 80D dividers have all resistance components immersed in oil within a hermetically sealed container. As an additional feature, all 80D and 80E models are provided with a 1 volt tap which allows measurements of high voltages with a laboratory potentiometer. Specifications for the standard models are shown on next page. Other intermediate models are available upon special request.



MODEL 80A

MODEL 80D



MODEL 80E

| Model No. | Maximum Input Voltage | Total Resistance | Current Drawn At Max. Input | Division Ratio | | | Division Ratio Accuracy | Stability of Division Accuracy Per Year |
|---|---|---|---|---|---|---|---|---|
| | | | | 500V Out | 10V Out | 1V Out | | |
| 80A-1 | 1 KV | 1 M | 1 ma | 2:1 | —— | —— | ±0.015% | —— |
| 80A-2 | 2 KV | 2 M | 1 ma | 4:1 | —— | —— | ±0.015% | —— |
| 80E-5 | 5 KV | 5 M | 1 ma | — | 500:1 | 5,000:1 | ±0.01% | ±0.01% |
| 80E-10 | 10 KV | 10 M | 1 ma | — | 1000:1 | 10,000:1 | ±0.01% | ±0.01% |
| 80D-30 | 30 KV | 30 M | 1 ma | 60:1 | 3000:1 | 30,000:1 | ±0.01% | ±0.01% |

| MODELS | SIZE | INPUT CONNECTOR | OUTPUT CONNECTOR |
|---|---|---|---|
| 80A | 6-3/4" high<br>5-1/4" wide<br>2-1/4" deep | UG-560U with mating connector supplied | Insulated binding posts on 3/4" centers |
| 80E | 7" high<br>8-1/2" wide<br>8" deep | MS3102A-18-165 with mating connector supplied | Insulated binding posts on 3/4" centers for both outputs |
| 80D | 13" high<br>9-3/4" wide<br>16" deep | Special 5" ceramic standoff with mating 6" guard supplied | Insulated binding post on 3/4" centers for both outputs |

MODEL A88 ISOLATION AMPLIFIER

## 6-3. ISOLATION AMPLIFIER

6-4. The FLUKE Model A88 all solid-state isolation amplifier is designed to provide isolation between the output of a differential voltmeter and the input of a recorder. Thus, the A88 will allow the use of a wide range of strip chart recorders for recording the voltmeter reading without regard to the input isolation characteristics of the recorder. The A88 is also excellent for making accurate dc microvolt and nanoampere measurements in the presents of common mode voltages up to 1100 vdc and 3 vac, 50 to 500 cycles.

GAIN: 1 volt output per microampere input.

GAIN ACCURACY: ±2%.

INPUT CURRENT RANGE: 0 to 2 microamperes.

INPUT VOLTAGE RANGE: 0 to 2 millivolts nominal.

INPUT RESISTANCE: 950 ohms (±5%).

OUTPUT VOLTAGE RANGE: 0 to 2 volts open circuit.

OUTPUT RESISTANCE: 1000 ohms (±5%).

INPUT ISOLATION FROM CHASSES: Greater than $5 \times 10^{11}$ ohms at 25°C (77°F), 60% RH and $1 \times 10^{10}$ ohms at 50°C (122°F), 80% RH.

# APPENDIX A

# FEDERAL SUPPLY CODE FOR MANUFACTURERS

## A-1. CODE TO NAME

**A-2.** The following five-digit code numbers are listed in numerical sequence along with the manufacturer's name and address to which the code has been assigned. The Federal Supply Code has been taken from Cataloging Handbook H 4-2, Code to Name. Suppliers not listed in the Federal Supply Code for Manufacturers have been assigned an alphabetical code by FLUKE.

| | |
|---|---|
| 00213 | Sage Electronics Corp.<br>Rochester, New York |
| 00327 | Welwyn International, Inc.<br>Cleveland, Ohio |
| 00656 | Aerovox Corp.<br>New Bedford, Massachusetts |
| 01121 | Allen-Bradley Company<br>Milwaukee, Wisconsin |
| 01281 | Pacific Semiconductors Inc.<br>Lawndale, California |
| 01295 | Texas Instruments, Inc.<br>Semiconductor Components Div.<br>Houston, Texas |
| 01730 | Circle Mfg. Co. Inc.<br>Little Falls, New Jersey |
| 01884 | Dearborn Electronic Labs Inc.<br>Orlando, Florida |
| 01963 | Cherry Electrical Products Corp.<br>Highland Park, Illinois |
| 02660 | Amphenol-Borg Elect. Corp.<br>Chicago, Illinois |
| 02606 | Fenwal Laboratories Inc.<br>Framington, Massachusetts |
| 02799 | Arco Capacitors, Inc.<br>Los Angeles, California |
| 03614 | Bussmann Mfg. Div. of<br>McGraw-Edison Co.<br>Los Angeles, California |
| 03615 | Ohmite Mfg. Co.<br>Los Angeles, California |
| 03877 | Transitron Electronic Corp.<br>Wakefield, Massachusetts |
| 03911 | Clairex Corp.<br>New York, New York |
| 03980 | Muirhead Instruments, Inc.<br>Mountainside, New Jersey |
| 04009 | Arrow Hart and Hegemen<br>Electronic Company<br>Hartford, Connecticut |
| 04062 | Elmenco Products Company<br>New York, New York |
| 04202 | Winchester Electronics Co.<br>New Milford, Connecticut |
| 04221 | Telex-Aemco Division<br>of Telex Corp.<br>Mankato, Minnesota |
| 04645 | Kurz-Kasch, Inc.<br>Chicago, Illinois |
| 04713 | Motorola Inc.<br>Semiconductor Products Division<br>Phoenix, Arizona |
| 05082 | Tung-Sol Electric Inc.<br>Melrose Park, Illinois |
| 05278 | Penn-East Engrg. Corp.<br>Kutztown, Pennsylvania |
| 05397 | Union Carbide Corp. Linde<br>Division Kemet Dept.<br>Cleveland, Ohio |
| 05571 | Sprague Electric Company<br>Culver City, California |
| 05704 | Alac, Inc.<br>Glendale, California |
| 06001 | General Electric Company<br>Capacitor Department<br>Irmo, South Carolina |
| 06136 | Ward Leonard Electric Co.<br>Los Angeles, California |
| 06473 | Amphenol Space and Missile Sys<br>Chatsworth, California |
| 06555 | Beede Electrical Inst. Co.<br>Penacook, New Hampshire |
| 06751 | Nuclear Corporation of<br>America, Inc.<br>U. S. Semcor Div.<br>Phoenix, Arizona |
| 06860 | Gould National Batteries Inc.<br>La Puente, California |
| 07115 | Corning Glass Works<br>Electronic Components Dept.<br>Bradford, Pennsylvania |
| 07263 | Fairchild Semiconductor<br>Div. of Fairchild Camera<br>and Instrument Corp.<br>Mountain View, California |
| 07344 | Bircher Co., Inc.<br>Rochester, New York |
| 07792 | Lerma Engineering Corp.<br>Northampton, Massachusetts |
| 07910 | Continental Device Corp.<br>Hawthorne, California |
| 08530 | Reliance Mica Corp.<br>Brooklyn, New York |
| 08863 | Nylomatic Corp.<br>Morrisville, Pennsylvania |
| 08988 | Skottie Electronics Inc.<br>Peckville, Pennsylvania |
| 11237 | Chicago Telephone of Calif Inc.<br>South Pasadena, California |
| 11503 | Keystone Mfg. Co.<br>Warren, Michigan |
| 12060 | Diodes, Inc.<br>Chatsworth, California |
| 12136 | Philadelphia Handle Co.<br>Camden, New Jersey |
| 12400 | International Resistance Co.<br>Control Components Division<br>Philadelphia, Pennsylvania |
| 12617 | Hamlin Inc.<br>Lake Mills, Wisconsin |
| 12697 | Clarostat Mfg. Co.<br>Dover, New Hampshire |
| 14099 | Semtech Corp.<br>Newbury Park, California |
| 14193 | California Resistor Corp.<br>Santa Monica, California |
| 14298 | American Components Inc.<br>Conshohocken, Pennsylvania |
| 14752 | Electro Cude Inc.<br>South Pasadena, California |
| 15818 | Amelco Inc.<br>Mountain View, California |
| 15909 | Daven Division<br>Thomas A. Edison Ind.<br>McGraw Edison Co.<br>Livingston, New Jersey |
| 16332 | Milwaukee Relays Inc.<br>Cedarburg, Wisconsin |
| 16473 | Cambridge Scientific<br>Industries Inc.<br>Cambridge, Maryland |
| 17069 | Circuit Structures Lab<br>Santa Ana, California |
| 17856 | Siliconix Inc.<br>Sunnyvale, California |
| 17910 | Continental Device Corp.<br>Hawthorne, California |
| 18083 | Clevite Corp.<br>Transistor Division<br>Palo Alto, California |
| 19429 | Montronics, Inc.<br>Seattle, Washington |
| 19701 | Electra Mfg. Co.<br>Independence, Kansas |
| 24655 | General Radio Co.<br>West Concord, Mass. |
| 28520 | Heyman Mfg. Co.<br>Kenilworth, New Jersey |
| 33173 | General Electric Co.<br>Tube Dept.<br>Owensboro, Kentucky |
| 37942 | P. R. Mallory and Co., Inc.<br>Indianapolis, Indiana |
| 38315 | Honeywell Inc.<br>Precision Meter Division<br>Manchester, New Hampshire |
| 42498 | National Company, Inc.<br>Malden, Massachusetts |
| 44655 | Ohmite Mfg. Co.<br>Skokie, Illinois |
| 49671 | Radio Corp. of America<br>New York, New York |
| 53021 | Sangamo Electric Co.<br>Springfield, Illinois |
| 55026 | Simpson Electric Company<br>Chicago, Illinois |
| 56289 | Sprague Electric Co.<br>North Adams, Mass. |
| 58474 | Superior Electric Co.<br>Bristol, Connecticut |
| 60399 | Torrington Mfg. Co.<br>Torrington, Connecticut |
| 62460 | USHCO Mfg. Co., Inc.<br>Buffalo, New York |
| 64834 | West Mfg. Co.<br>San Francisco, California |
| 65092 | Weston Instruments<br>Div. of Daystrom, Inc.<br>Newark, New Jersey |
| 66150 | Winslow Tele-Tronics Inc.<br>Asbury Park, New Jersey |
| 70563 | Amperite Co.<br>Union City, New Jersey |
| 70903 | Belden Mfg. Co.<br>Chicago, Illinois |

| | |
|---|---|
| 71400 | Bussman Manufacturing Division of McGraw Edison Co. St. Louis, Missouri |
| 71450 | CTS Corp. Elkhart, Indiana |
| 71468 | Cannon Electric Company Los Angeles, California |
| 71482 | Clare, C. P. and Company Chicago, Illinois |
| 71590 | Centralab Div. of Globe Union, Inc. Milwaukee, Wisconsin |
| 71707 | Coto Coil Co., Inc. Providence, Rhode Island |
| 71744 | Chicago Miniature Lamp Works Chicago, Illinois |
| 71785 | Cinch Mfg. Co. and Howard B. Jones Div. Chicago, Illinois |
| 72005 | Driver, Wilber B., Co. Newark, New Jersey |
| 72092 | Eitel-McCullough, Inc. San Bruno, California |
| 72136 | Electro Motive Mfg. Co. Willimantic, Connecticut |
| 72354 | Fast, John E. Co. Div. of Victoreen Instr. Co. Chicago, Illinois |
| 72559 | Essex Electronics Inc. Berkeley Heights, New Jersey |
| 72619 | Dialight Corp. Brooklyn, New York |
| 72665 | Mallory Battery Company Cleveland, Ohio |
| 72982 | Erie Tech. Products Inc. Erie, Pennsylvania |
| 73138 | Helipot Division of Beckman Instruments Inc. Fullerton, California |
| 73293 | Hughes Products Div. of Hughes Aircraft Co. Newport Beach, California |
| 73445 | Amperex Electronic Co. Div. of North American Philips Co., Inc. Hicksville, New York |
| 73559 | Carling Electric Inc. Hartford, Connecticut |
| 73586 | Circle F Mfg. Co. Trenton, New Jersey |
| 73899 | JFD Electronics Corp. Brooklyn, New York |
| 73949 | Guardian Electric Mfg. Co. Chicago, Illinois |
| 74217 | Radio Switch Corp. Marlboro, New Jersey |
| 74306 | Piezo Crystal Company Carlisle, Pennsylvania |
| 74542 | Hoyt Elect. Instr. Works Penacook, New Hampshire |
| 74970 | Johnson, E. F., Co. Waseca, Minnesota |
| 75042 | International Resistance Co. Philadelphia, Pennsylvania |
| 75915 | Littelfuse Inc. Des Plaines, Illinois |
| 76854 | Oak Mfg. Co. Crystal Lake, Illinois |
| 77342 | American Machine and Foundry Company Potter & Brumfield Div. Princeton, Indiana |
| 77969 | Rubbercraft Corp. of California Ltd. Torrance, California |
| 78277 | Sigma Instruments, Inc. South Braintree, Mass. |
| 79136 | Waldes Kohinoor Inc. Long Island City, New York |
| 79497 | Western Rubber Company Goshen, Indiana |
| 80031 | Mepco Division of Sessions Clock Co. Morristown, New Jersey |
| 80294 | Bourns Laboratories, Inc. Riverside, California |
| 80583 | Hammarlund Company, Inc. New York, New York |
| 80640 | Stevens, Arnold Co., Inc. Boston, Massachusetts |
| 81073 | Grayhill Company La Grange, Illinois |
| 81439 | Therm-O-Disc Inc. Mansfield, Ohio |
| 81483 | International Rectifier Corp El Segundo, California |
| 81590 | Korry Mfg. Co. Seattle, Washington |
| 82376 | Astron Division Renwell Industries Inc. East Newark, New Jersey |
| 82389 | Switchcraft Inc. Chicago, Illinois |
| 82872 | Roanwell Corp. Brooklyn, New York |
| 82877 | Rotron Mfg. Co., Inc. Woodstock, New York |
| 82879 | Royal Electric Corp. Pawtucket, Rhode Island |
| 83003 | Varo Mfg. Co., Inc. Garland, Texas |
| 83298 | Bendix Corp. Red Bank Division Red Bank, Eatontown, New Jersey |
| 83330 | Smith, Herman H., Inc. Brooklyn, New York |
| 83478 | Rubbercraft Corp. of Am. New Haven, Connecticut |
| 84411 | Good All Electric Mfg. Co. Ogallala, Nebraska |
| 86689 | R. M. B. Corp. Los Angeles, California |
| 88419 | Cornell-Dubilier Elec. Corp. Electro-Mechanical Div. Fuquay Springs, North Carolina |
| 88690 | Essex Wire Corp. R. B. M. Division Detroit, Michigan |
| 89536 | Fluke, John, Mfg. Co., Inc. Seattle, Washington |
| 89730 | General Electric Company Newark Lamp Works of Lamp Division of Consumer Products Group GECO Newark, New Jersey |
| 90205 | Best Stamp and Mfg. Co. Kansas City, Missouri |
| 90211 | Square D Company Chicago, Illinois |
| 90303 | Mallory Battery Company North Tarrytown, New York |
| 91293 | Johanson Mfg. Co. Boonton, New Jersey |
| 91407 | Superior Electric Company Oak Park, Illinois |
| 91662 | Elco Corp. Willow Grove, Penn. |
| 91737 | Gremar Mfg. Co., Inc. Wakefield, Massachusetts |
| 91802 | Industrial Devices, Inc. Edgewater, New Jersey |
| 91929 | Minneapolis Honeywell Regulator Company Micro Switch Division Freeport, Illinois |
| 91934 | Miller Electric Co., Inc. Pawtucket, Rhode Island |
| 93332 | Sylvania Electric Products Inc. Semiconductor Products Division Woburn, Massachusetts |
| 94145 | Raytheon Company Semiconductor Division California Street Plant Newton, Massachusetts |
| 95146 | Alco Electronics Mfg. Co. Lawrence, Massachusetts |
| 95264 | Lerco Electronics Inc. Burbank, California |
| 95303 | Radio Corp. of America Comm. Receiving Tube & Semiconductor Division Cincinnati, Ohio |
| 95354 | Methode Mfg. Co. Chicago, Illinois |
| 95712 | Dage Electric Co., Inc. Franklin, Indiana |
| 96733 | San Fernando Electric Mfg. Co. San Fernando, California |
| 96881 | Thomson Industries, Inc. New Hyde Park Long Island, New York |
| 97945 | S. S. White Dental Mfg. Co. Plastics Division New York, New York |
| 97966 | CBS Electronics Div. of Columbia Broadcasting System, Inc. Danvers, Massachusetts |
| 98094 | Penta Laboratories, Inc. Santa Barbara, California |
| 98388 | Accurate Sales Company Culver City, California |
| 98743 | James Vibrapower Corp. Chicago, Illinois |
| 98925 | Semiconductor Division of Clevite Corp. Waltham, Massachusetts |
| 99120 | Plastic Capacitors, Inc. Chicago, Illinois |
| 99217 | Southern Electronics Corp. Burbank, California |
| 99515 | Marshall Industries Electron Prod. Div. Pasadena, California |

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Using H4-2 Dated March 1963